

AUTO – DELIVERY STRATEGIES REQUIRED TO MOBILIZE FARMERS TO ADOPT THE USE OF ORGANIC FERTILIZERS IN SOUTH-EAST NIGERIA

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The study was carried out to identify the auto – delivery strategies required to mobilize farmers to adopt the use of organic fertilizers in South-East Nigeria. The study adopted descriptive survey research design. The population of the study was 1,812. This is made up of 1250 Registered Farmers, 384 Extension Agents, and 178 Lecturers. The sample for the study is 912. In arriving at the sample, all 384 Agricultural Extension Agents and 178 Lecturers of Agriculture was used for the study. For the 1250 Registered Farmers in the population, proportionate random sampling technique was used to select 20% of the Registered Farmers from each state with an expected total of 350. The instrument used for collecting data was questionnaire titled Auto-delivery Strategies Questionnaire (ASQ). The instrument was developed by the researcher and it was validated by five experts. The instrument was tested for reliability using kuder-Richardson (K-20) formula and the reliability index was 0.75. The instrument was administered through the help of five research assistants. The instrument was distributed and collected after three weeks and all were returned representing 100% retrieval rate. The data collected were analyzed using Mean, and Standard Deviation. The result shows that the auto – delivery strategies required to mobilize farmers to adopt the use of organic fertilizers in South-East Nigeria include offering grants and incentives to farmers; conducting educational awareness programmes about the importance of using organic fertilizers; organizing training for farmers on the use of organic fertilizers; advocacy on the importance of organic fertilizers in protecting the environment; policy intervention to regulate the use of chemical fertilizer; and 33 others. It was recommended that the different levels of government in South-East Nigeria should develop the strategies into training programmes for farmers; more farmers should be trained on how to handle computers to improve their ability to utilize internet of things among three others.

Background of the Study

Nigeria is one of the countries in West Africa with natural agricultural endowment of massive green vegetation, arable lands and favourable climate used for producing different crops. But despite the natural endowment, food availability is threatened. Botir, Hye, Yejin, Farrukh, Thi, Mirijalol, Aung, Kwang, and Kee, (2019) noted that, the continuously increasing population in the world put pressure on agriculture to produce more food because lesser number of people venture into farming. To meet with food production needs, most farmers use fertilizers. Ibode, Akintola, Tunde-francis, Owolola,, Afolabi and Ademigbuji (2022) stated that, fertilizer is one of the additives that is added to the soil for enhancement of agricultural productivity and sustainability. The need for fertilizer arose because plant nutrients in the soil have been depleted as a result of continuous cropping by farmers without replenishing the nutrients. The fertilizers mostly available to farmers are inorganic single or compound fertilizers like Nitrogen Phosphorus and Potassium (N.P.K) among others. The raw materials for the production of these inorganic fertilizers are usually imported outside Nigeria and blended in some parts of the country. Because of none availability of the raw materials in the country, inorganic fertilizers are usually very expensive after blending. Similarly, most of these inorganic fertilizers contain poisonous substances that are not safe to man and crops when used continuously in a particular soil. Botir et al (2019) stated that the application rate of chemical fertilizers has soared extensively during the last decades to enhance crop yield in order to meet the increasing demand of the population but the consequences are serious ecological disturbances, pollution of soil and water resources. Similarly, available fertilizers are no longer affordable.

Observation by the researcher shows that despite multiples of intervention and subsidies given to farmers by federal, states and local governments in the country for the purchase and supply of soil inputs, the price of inorganic fertilizers are still high in the market. The researcher also observe that the high cost of inorganic fertilizer is as a result of the Russian – Ukrainian war which affected the supply of raw material used in the production of inorganic fertilizers from Ukrainian. Because of this development, inorganic fertilizers are no longer affordable for the farmers in our locality. The result is that many crop farmers find it difficult to procure fertilizers for their crops thereby allowing most of their crops to grow naturally without additional supportive nutrients. This affects their total productivity index thereby affecting food consumption as well as the number of food available for sell in the market thus affecting food security.

Food security is a state of having a reliable access to sufficient quantity of affordable nutritious food. It can also be seen as a measure of the availability of food and individual's ability to access it for consumption at the right time and place. Mercy Corps Organization (2015) defined food security as a development outcome that can be achieved when all people at all times consume sufficient, safe and nutritious food and practice behaviors that promote both their sustainable economic productivity and well being. United Nation Committee for Food Security (2019) define food security as a situation where all people at all times have food and economic access to sufficient, safe and nutritious food that meet their food preference and dietary needs for an active and healthy life. It is the importance attached to food security that the United Nations (2016) included food security in the Sustainable Development Goal of 2016 – 2030. The document specifies that by 2030 it should:

'' End hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round''

To achieve the above goal especially in Nigeria, there is need for farmers to use locally sourced and blended organic fertilizers that are cheap and affordable for growing crops. Organic fertilizers are derived from organic manure which is from plant and animal origin that are used as fertilizers by farmers for the growing of crops. Different types of organic manure exist which are used by farmers. They include: green manure which is derived from ploughing green grasses back to the soil; compost manure which is derived from a mixture of dried plant leaves, shrubs, top soil, humus soil and wood ash; animal manure which is derived from human and animal dungs as well as dead animals; and farm yard manure which is derived from kitchen waste from crops and animals, among others in a raw form. According to Orozco-Aceves, Calvo-Araya, Gamboa-Tabares, Peraza-Padilla, Varela-Rodríguez, Orozco-Rodríguez, (2017), organic manure comprises of natural fertilizers that improves the soil physical, chemical and biological properties. Botir et al (2019) stated that organic manure is a natural source of nitrogen (N) formation process in the soil and livestock manure returns essential macro elements including N (2.42%), P (1.51%), and K (0.41%) as well as micro nutrients such as magnesium, calcium, sulphure and manganese to the soil while maintaining its fertility. When organic manures are processed to fertilizers, a lot of advantages are inherent. Some of the advantages include that: it is cheap, safe to use, contains different types of soil active nutrients/ingredients, and the raw materials are readily available and can be sourced locally without importation among others.

Despite the advantages of organic fertilizers, most farmers in South-East, Nigeria do not use them. Azunku and Igwe (2021) stated that in Nigeria, researchers have developed granulated and liquid fertilizers for crop production, but there is low adoption in the use of the products by farmers. Nnadozie, F. E. (2022) found out that the poor adoption of new agricultural information by farmers can be attributed to ineffective extension delivery. The author added that most farmers are poorly informed of developments in agricultural sector. Ukoje and Yusuf (2022) stated noted that adoption of information in agricultural sector by farmers require establishment of visible demonstration farms and author - delivery of research findings to farmers. The authors added that the situation is such that, most farmers still use on improved varieties of plants that have been improved upon a long time ago.

The solution to improving farmers' use of organic fertilizers lies in the automation of information dissemination so that it will be an avenue to mobilize them. Auto-delivery is the process of transmitting information about organic fertilizer usage directly to farmers using way bills, internet of Things (IoT) media and modern marketing system. Auto-delivery serves as an act of getting farmers ready for action through the electronic transmission of information related to them. In business, auto-delivery is a process by which customer's sign up for pre-scheduled purchases and the goods are directly delivered to them at the comfort of their homes. This process saves time and also helps businesses get more sustainable and predictable orders. Auto-delivery of information to farmers requires the intervention of government agencies; influential individuals; non-governmental organizations; and using internets of things (IOT) to improve assess of farmers to relevant information about the use of organic fertilizer. If organic fertilizers are auto-delivered to farmers, information about how to use it as written in the factory after packaging will get directly to them. This could be tremendous in reducing guesswork in the use of organic fertilizers and help the farmers to select the needed plant nutrients in amount adequate to correct deficiencies before and after cropping. It could also make the farmer to have direct access to the producers. Such organic fertilizers could be cheaper in the market since the over dependence in the importation of raw material for the production of inorganic fertilizers which led to its high cost do not apply again. This study therefore aims at determining auto – delivery strategies required to mobilize farmers to adopt the application of organic fertilizers in South-East, Nigeria.

Research Questions

The following research questions will guide the study:

1. what are the roles of government agencies in the auto- delivery strategies required to mobilize farmers to adopt the use of organic fertilizers?;
2. what are the roles of influential individuals and non-governmental organizations in the auto- delivery strategies required to mobilize farmers to adopt information on the use of organic fertilizers?; and
3. what are the Internet of Things (IoT) required for automating the delivery of strategies required to mobilize farmers' to adopt the use of organic fertilizers?

Methods

Research Design

The study adopted quantitative design approached. Through quantitative means, the researchers adopt descriptive survey by distributing questionnaire and analyzing the results after collection.

Area of study

The study was carried out in South-East Geo-Political Zone of Nigeria. South-East, Nigeria is made up of five states namely: Abia, Anambra, Ebonyi, Enugu, and Imo States. The area is occupied by a tribe called the Igbos whose main occupation is trading and farming. Because of that, there is high level of farming activities taking place in the area. The area is also found in the rainforest belt with moderate temperature, wind, sunlight, rainfall, pressure and humidity which favours crop production. Because of that, the zone favours the growth of crops like yam, cassava, rice, maize, guinea corn, groundnut, sweet potatoes, beans, and different types of vegetables. The study is therefore timely in South-East Nigeria since in the geopolitical zone has many farmers that could use organic fertilizers if auto delivered to them.

Population for the Study

The population for the study was 1,812. This is made up of 1250 Registered Farmers, 384 Extension Agents, and 178 Lecturers. The population of Registered Farmers and the Extension Agents was obtained from the State Ministries of Agriculture in Abia, Anambra, Ebonyi, Enugu and Imo after a request has been written to them. The population of the lecturers was obtained from the faculties of agriculture from universities in South-East Geo-political Zone, of Nigeria. The Registered Farmers, Extension Agents and Lecturers of Agriculture provided data for the determination of the auto-delivery strategies. The population is considered appropriate because,

all of them are experienced in farming activities and possess technical abilities to provide response on what should be part of auto-delivery strategies in organic fertilizer use.

Sample and Sampling Techniques

The sample for the study is expected to be 912 respondents. This is made up of 350 Registered Farmers, 384 Agricultural Extension Agents, and 178 Lecturers of Agriculture. All 384 Agricultural Extension Agents and 178 Lecturers of Agriculture was used for the study. For the 1250 Registered Farmers in the population, proportionate random sampling technique was used to select 20% of the Registered Farmers from each state with an expected total of 350. Proportionate sampling technique was used because it gave the researcher opportunity to select respondents based on their total number in each state and also give the respondents equal opportunity of being selected to participate in the research.

Instrument for Data Collection

One instrument was used to collect data for the study. The instrument is Auto-delivery Strategies Questionnaire (ASQ). The Auto-delivery Strategies Questionnaire (ASQ) was divided into two parts, namely part 1 and 2. Part 1 sought for information on personal data of the respondents while part two consist of items in three clusters: A, B, and C, which provided answers to research questions one to three. Each item in the three clusters had a four points response options of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with a corresponding values of 4,3, 2 and 1 respectively.

Validation of the Instrument

To ascertain the validity of the instruments used in the study, the researchers gave the questionnaire to five experts for face validation. They are two lecturers from the Department of Agricultural Extension, University of Nigeria, Nsukka; two Extension Agents from Ministry of Agriculture, Ebonyi State; one registered farmers from Enugu State Ministry of Agriculture. They were given all the instruments together with the research purpose, questions, hypotheses and method of data analysis. They were specifically requested to examine the instruments to ensure that the items relate to the purpose of the study, the research questions and the formulated hypotheses. They were also requested to make comments based on the clarity, appropriateness, language, adequacy and content coverage of the instruments. There comments helped to improve the instruments.

Reliability of the Instrument

To determine the reliability of the Auto-delivery Strategies Questionnaire, the instrument was subjected to a pilot testing. This was done by administering the instrument to 50 Registered Farmers and 50 Extension Agents from Cross River State. The choice of Cross River State is that the state is located within the rain forest area like all the states in South-East. Also many farmers grow different types of crops in the state. After the administration and collection of the instruments, Cronbach Alpha was used to determine the internal consistency of the instrument.

Method of Data Collection

The administration of the instruments was in two phases.

Phase One: This phase was the administration of the Auto-delivery Strategies Questionnaire (ASQ). The researcher first selected five research assistants who were used for the administration of the instrument. The research assistants were graduates of agricultural programmes from recognized tertiary institutions with B. Sc, B. Agric or HND and are either teachers of agriculture from secondary schools or extension agents in state ministries of agriculture. The five research assistants helped in the distribution and collection of the questionnaire. All the research assistants were trained on how to distribute and collect the data.

Data analysis

Data collected was analyzed using Mean ($\bar{X}$), Standard Deviation, (SD) to answer research questions 1 – 3. In determining the level of acceptance of each item in the questionnaire using mean and standard deviations, the upper and lower limits of four points (real limits) were used to take decision on the data collected. This is shown below:

Nominal Value	Range of Mean	Decision
4	3.50-4.00	Strongly Agree
3	2.50-3.49	Agree
2	1.50-2.49	Disagree
1	0.50- 1.49	Strongly Disagree

Any strategy with a mean in the range of 2.50 and above was regarded as agreed and was included as the strategies while any item with a mean below 2.49 and was regarded as disagreed and not accepted. In taking decision on standard deviation, any strategy that is less than the table value of 1.96 was considered as being close to the mean and was accepted while standard deviation of any strategy that is greater than the table value of 1.98 was considered as being too far from the mean

and rejected. The whole data will be analyzed with Statistical Package for the Social Science (SPSS) version 20.

Results

Research question 1: What are the roles of government in the auto- delivery strategies required to mobilize farmers to adopt the use of organic fertilizers?

Mean and Standard Deviation ratings of the two groups of respondents on the roles of government in the auto- delivery strategies required to mobilize farmers to adopt the use of organic fertilizers
N= 912

S/N	Items statement	$\bar{x}$	SD	Table value	Remarks
1	Offering grants and incentives to farmers	2.63	0.15	1.98	Needed
2	Conducting educational awareness programmes about the importance of using organic fertilizers	2.54	0.40	1.98	Needed
3	Organizing training for farmers on the use of organic fertilizers	2.60	0.40	1.98	Needed
4	Advocacy on the importance of organic fertilizers in protecting the environment	2.60	0.66	1.98	Needed
5	Policy intervention to regulate the use of chemical fertilizer	2.80	0.06	1.98	Needed
6	Subsidizing the price of organic fertilizers	2.60	0.40	1.98	Needed
7	Distributing organic fertilizers free to farmers	3.00	1.02	1.98	Needed
8	Establishing demonstration farms that uses organic fertilizers in farming	2.70	1.10	1.98	Needed
9	Boasting the use of organic fertilizers by providing it to farmers	3.50	0.01	1.98	Needed
10	Paying counterpart funds for the supply of organic fertilizers in state ministries of agriculture	3.60	0.20	1.98	Needed
11	Controlling the price of organic fertilizers in the market	2.80	0.06	1.98	Needed
12	Empowering farmers to buy organic fertilizers	2.60	0.42	1.98	Needed

$\bar{X}$ = Mean, SD = Standard Deviation

The data in table 1 above reveals that the respondents acceptable all the 12 items in research question one as the roles of government in the auto- delivery strategies required to mobilize

farmers to adopt the use of organic fertilizers. In the table all the items had a mean in the range of 2.50-3.60. This shows that each of the mean is above the cut-off point of 2.50 and were all needed. The Standard Deviation is between 0.01 – 1.10 which is below the table value of 1.98. This shows that they are close to one another and not too far from the mean in their deviations. Because of that all the items presented were accepted.

Research Question 2: What are the roles of influential individuals and non-governmental organizations in the auto- delivery strategies required to mobilize farmers to adopt information on the use of organic fertilizers?

Mean and Standard Deviation ratings of the two groups of respondents on the roles of influential individuals and non-governmental organizations in the auto- delivery strategies required to mobilize farmers to adopt information on the use of organic fertilizers

N= 912

S/N	Items statement	$\bar{x}$	SD	Table value	Remarks
13	Assisting farmers to gain access to credits	2.59	0.48	1.98	Needed
14	Organizing awareness campaigns for farmers	3.31	0.41	1.98	Needed
15	Organizing seminars on the use of organic fertilizers to farmers	3.76	0.02	1.98	Needed
16	Organizing conferences on the use of organic fertilizers	2.53	0.43	1.98	Needed
17	Establishing organic fertilizers farms in communities	2.56	0.47	1.98	Needed
18	Assisting farmers in decision making	3.00	0.28	1.98	Needed
19	Establishment of farmer Education Clinics	3.15	0.31	1.98	Needed
20	Organizing training for farmers on the use of organic fertilizers	2.97	0.31	1.98	Needed
21	Subsidizing the price of organic fertilizers	3.27	0.07	1.98	Needed
22	Printing flyers and poster containing information about the use of organic fertilizers	2.95	0.06	1.98	Needed

X = Mean, SD = Standard Deviation

The data in table 2 above reveals that the respondents acceptable all the 10 items in research question two as the roles of influential individuals and non-governmental organizations in the auto-delivery strategies required to mobilize farmers to adopt information on the use of organic fertilizers. In the table, all the items had a mean in the range of 2.53-3.76. This shows that each of the mean is above the cut of point of 2.50 and were all needed. The Standard Deviation is between

0.02 – 1.00 which is below the table value of 1.98. This shows that the items in their deviations are close to one another and not too far from the mean. Because of that all the items presented were accepted.

Research Question 3: What are Internet of Things (IoT) required for automating the delivery of strategies required to mobilize farmers’ to adopt the use of organic fertilizers?

Mean and Standard Deviation ratings of the two groups of respondents on the Internet of Things (IoT) required for automating the delivery of strategies required to mobilize farmers’ to adopt the use of organic fertilizers

N= 912

S/N	ITEMS	$\bar{x}$	SD	Table value	Remarks
23	Using software to make new orders	2.60	0.47	1.98	Needed
24	Processing payments online	2.80	1.00	1.98	Needed
25	Preparing and sending notification to customers	3.60	0.06	1.98	Needed
26	Use of soil moisture sensor	3.50	0.20	1.98	Needed
27	Use of visible light sensor	2.70	0.02	1.98	Needed
28	Use of data driven decision making process	3.00	1.00	1.98	Needed
29	Use of electrochemical sensor for nutrient detection	3.60	0.42	1.98	Needed
30	Products monitoring	3.60	0.06	1.98	Needed
31	Video enabled monitoring	3.50	0.20	1.98	Needed
32	Use of autonomous vehicles	2.70	0.02	1.98	Needed
33	Proper fleet management	3.00	1.00	1.98	Needed
34	infotainment	2.53	0.40	1.98	Needed
35	Predictive maintenance	2.80	0.66	1.98	Needed
36	Optimal route planning	2.60	0.40	1.98	Needed
37	Monitoring of climatic condition	3.00	1.02	1.98	Needed

X = Mean, SD = Standard Deviation

The data in table 2 above reveals that the respondents acceptable all the 17 items in research question two as the values that students of agriculture in colleges of education must possess for effective learning of agriculture in colleges of education. In the table, all the items had a mean in the range of 2.53-3.76. This shows that each of the mean is above the cut of point of 2.50 and were

all needed. The Standard Deviation is between 0.02 – 1.00 which is below the table value of 1.98. This shows that the items in their deviations are close to one another and not too far from the mean. Because of that all the items presented were accepted.

Summary of Findings

From the finding of the study on research question one, the respondents accepted the following as the roles of government in the auto- delivery strategies required to mobilize farmers to adopt the use of organic fertilizers: Offering grants and incentives to farmers; Conducting educational awareness programmes about the importance of using organic fertilizers; Organizing training for farmers on the use of organic fertilizers; Advocacy on the importance of organic fertilizers in protecting the environment; Policy intervention to regulate the use of chemical fertilizer; Subsidizing the price of organic fertilizers; Distributing organic fertilizers free to farmers; Establishing demonstration farms that uses organic fertilizers in farming; Boasting the use of organic fertilizers by providing it to farmers; Paying counterpart funds for the supply of organic fertilizers in state ministries of agriculture; Controlling the price of organic fertilizers in the market; and Empowering farmers to buy organic fertilizers.

In research question two, the respondents accepted the following as the roles of influential individuals and non-governmental organizations in the auto- delivery strategies required to mobilize farmers to adopt information on the use of organic fertilizers: Assisting farmers to gain access to credits; Organizing awareness campaigns for farmers; Organizing seminars on the use of organic fertilizers to farmers; Organizing conferences on the use of organic fertilizers; Establishing organic fertilizers farms in communities; Assisting farmers in decision making; Establishment of farmer Education Clinics; Organizing training for farmers on the use of organic fertilizers; Subsidizing the price of organic fertilizers; and Printing flyers and poster containing information about the use of organic fertilizers.

In research question three, the respondents accepted the following as the Internet of Things (IoT) required for automating the delivery of strategies that will mobilize farmers' to adopt the use of organic fertilizers: Using software to make new orders; Processing payments online; Preparing and sending notification to customers; Use of soil moisture sensor; Use of visible light sensor; Use of visible light sensor; Use of data driven decision making process; Use of electrochemical sensor for nutrient detection; Products monitoring; Video enabled monitoring; Use of autonomous

vehicles; Proper fleet management; infotainment; Predictive maintenance; Optimal route planning; and Monitoring of climatic condition.

Recommendations

Based on the findings of the study, the following are recommended

1. Different levels of government in South-East Nigeria should develop the strategies into training programmes for farmers
2. More farmers should be trained on how to handle computers to improve their ability to utilize internet of things
3. Wealthy individuals should pull resources and channel it towards creating awareness for farmers education towards the use of organic fertilizers
4. Non-governmental organizations and faith based organizations
5. Different state ministries of agriculture in the geo-political zone should deploy more extension agents to rural communities to increase farmer awareness campaign

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