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Agricultural Extension Communication Techniques and Farmers Adoption of Modern Technologies in Adamawa State

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Abstract: *The study was carried out to ascertain the relationship between agricultural extension communication techniques and farmers adoption of modern technologies in Adamawa State, Nigeria. Three research questions were answered and three hypotheses tested. The study adopted correlation research design. The population of this study was 1,389 farmers in Adamawa State. These farmers cuts across the different farming areas in the state. Taro Yameni formula was used to draft 310 farmers from the entire population for use in the study. Simple random sampling was further used to sample 310 farmers across all the accessible local governments in the state. The instrument for the study were two sets of questionnaires developed by the researcher and titled, Agricultural Extension Delivery Techniques Questionnaire (AEDTQ) and Level of Agricultural Technology Adoption Questionnaire (LATAQ). The two instruments consist of two sections, A and B. Section A was mainly for collecting personal information of the respondents while section B was designed to gather data concerning Agricultural Extension Delivery Techniques and level of agricultural technology adoption in the study area. The two questionnaires were placed on a four-point rating scale. The instruments were validated by three research experts in Agricultural Education Department, Joseph Sarwuan Tarka University, Makurdi. Each of the two instruments were administered once on 20 registered farmers in Gombe State. The data obtained were analyzed using Cronbach Alpha coefficient and a reliability of .77 and .73 were obtained for AEDTQ and LATAQ respectively which proves that the instruments are reliable for the study. 310 copies of the questionnaire were administered to the registered farmers with the help of 5 research assistance in the State. 289 copies (93%) of the questionnaire were retrieved and analyzed while 21 copies were lost. Pearson Product Moment (PPM) correlation was used to answer the research questions while linear regression was used to test hypotheses. It was found from the study that there is a very high level of relationship between agricultural extension communication techniques and farmers adoption of technology in Adamawa State. Among the recommendations made were that: Government through the extension agents should be encouraged to make policies and programs that will enable farmer to easily access information through mass media such as radio, televisions, newspapers social media and that extension agents should ensure that they create conducive, adequate, and enabling environment for exhibitions during green field show.*

Keywords: *Agricultural extension, communication techniques and farm technologies.*

Introduction

Agricultural extension is a training or re-training programme for making out of school farmers to be aware of alternatives from where they can choose the most desirable means as well as how the different methods or techniques that exist can assist in carrying out farming and other operations involved in food production using most updated technology. The main goal of agricultural extension is to improve the socio-economic condition of farmers and rural dwellers. As a discipline, it aims to determine how factors of production can be best utilized to improve the standard of living of rural dwellers through one or a combination of different extension methods

Agricultural extension is a process of getting useful information to farmers. According to Okey, (2021) agricultural extension is a programme that assists the farmers in acquiring necessary skills, knowledge and attitudes to utilize the modern technologies in agriculture effectively. The ultimate aim of agricultural extension is to raise the standard and efficiency of rural farmers through adoption of modern farming technology to achieve higher level of food production. Agricultural extension delivery techniques are methods used by extension agents or workers to achieve set goals or objectives. Extension services are critically important to agricultural development as they facilitate farmers' access to information, knowledge and technologies which can be applied to enhance agricultural production (Lwoga et. al., 2013). Agricultural extension agents usually apply different teaching methods or techniques in training the rural farmers with the notion that, the more the techniques used, the better the results obtained.

There are various extension teaching methods used as tools by the extension workers to effect desirable changes in the behaviour of farmers, arrange the best learning situations and provide opportunities in which useful communication and interaction takes place between extension workers and farmers. Such teaching methods/pathways include group training, demonstration plot, adopted villages, On - Farm Adaptive Research and mass media (Nwaekpe *et al.,* 2014). The extension delivery techniques in the context of this study are mass media, green field, small spot adoption technique (SPAT), individual discussion and group discussion techniques. Extension agents utilizes any of the above mediums where suitable to convey their messages to the understanding of the farmers. The technique adopted also depends on the type of message being passed. For instance, mass media could be used to pass information not involving practical while SPAT or group delivery can be used on practical oriented messages.

Farmers have been known to produce the bulk of food consumed in this country from pre-colonial era to the present day, in which most of their farm operations are based on fragmented holdings, intercropping practices and so on (Albert & Peter, 2018). It is noted that mixed cropping and shifting cultivation are generally practiced by farmers in the area of this study and yields of crops obtained have been declining in recent years. The decline seems to be attributed not to a reduction in period of bush fallow but also improper use of fertilizers and lack of orientation to the use of farming techniques by the farmers. Because of the seemingly low production and inadequate use of improved agricultural technologies and services to boost up food production by farmers, the federal government of Nigeria instituted the Agricultural Development project (ADP). The ADP is an agricultural extension agency that is charged with the responsibilities of teaching and

guiding the farmers and providing production recommendation and agricultural inputs to the farmers (Omonijo *et. al.*, 2014). This was done to ensure adoption of improved techniques and technology by the farmers and consequently increase agricultural output. Nwaekpe *et al. (*2014) maintained that the major objective of the Agricultural Extension is to teach the rural farmers to raise their standard of living with minimum assistance and by their own efforts. Extension services are critically important to agricultural development as they facilitate farmers' access to information/knowledge and technologies which can be applied to enhance their agricultural production. (Lwoga *et. al.,* 2010). Hence, agricultural Extension techniques are designed to feed the farmers with appropriate information in agricultural production; through provision of inputs of various types and nature of usage, conducting of diagnostic surveys to reveal farmers problems and to give possible solutions among others. However, it appears that most farmers do not have access or opportunity to receiving adequate training from the extension agents and as such they lack the techniques of improved methods of planting crops, applying fertilizers or raising animals.

In farmers training programmes, the efficiency of training process is observable when the farmer acquires and uses the farming technologies been taught to increase his/her production (Osinem, 2008). It is for this reason that farmer-training is important. The author noted that Agricultural Education is a strong weapon for improving agriculture in order to achieve its objectives as an instrument of development. This can take the form of Agricultural training to improve the skills of rural youths in their traditional organization so as to become familiar with modern agricultural techniques, use and maintenance of farm facilities. Osimen (2008) further stressed that it is essential to train rural youths to improve their knowledge of farm technology and technical skills so as to engage in agriculture and related occupations. By improving their technical skills, it is possible to work more effective and at the same time increase earning capacity of the rural population. Agricultural technology is the application of modern farming equipment and machines to enhance food production. Agricultural technology or agrotechnology (abbreviated agritech, AgriTech, or agrotech) is the use of technology in agriculture, horticulture, and aquaculture with the aim of improving yield, efficiency, and profitability. Agricultural technology can be products, services or applications derived from agriculture that improve various input/output processes (Ayaji, & Fapojuwo, 2013). Today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems allow businesses to be more profitable, efficient, safer, and more environmentally friendly. Some technologies applied in agricultural technology include: drones, satellite photography and sensors, IoT-based sensor networks, phase tracking, weather forecasts, automated irrigation, light and heat control, intelligent software analysis for pest and disease prediction, soil management and other involved analytical tasks and biotech (Pansak 2017). Agriculture has been wrongly perceived in the past as a "dirty job" for the old people in rural communities but with the renaissance Technology brought to Agriculture, young people now see it as a potential sector to explore.

In Nigeria, there is digital agriculture platform which focused on connecting farm sponsors with real farmers in order to increase food production while promoting youth

participation in agriculture. This agricultural technology startup is currently disrupting the agriculture ecosystem in the country by connecting small-scale farmers with investors using their platform App which is available on Google and Apple app stores. Farmers and sponsors all receive a percentage of the profits on harvest. The platform also makes provision for insurance cover for all existing farm projects, so that in the event of unforeseen circumstances, the sponsors' capital can be refunded.

Drones can be used on Crop field for scanning with compact multispectral imaging sensors, GPS map creation through onboard cameras, heavy payload transportation, and livestock monitoring with thermal-imaging camera-equipped drones (Albert & Peter, 2018). More so, Information Communication Technologies like podcasts, weblogs, social media platforms, e-books are constantly helping to bridge the information gap in the agriculture sector for farmers and agripreneurs. The recent soilless planting technology through hydroponics has also assisted to grow vegetables and tomatoes, guarantees an all-year-round production for farmers and insulates these crops from the effects of climate change (Soronnadi, 2019).

For farmers to gain the knowledge on the application of these agri-technologies, the extension agents explores the various techniques outlined above to educate the farmers. This points to the fact that there is a great deal of interdependence between the extension techniques and the adoption of the various agricultural technologies since the nature of the technology being extended to the rural farmers is likely to determine the extension technique to be adopted by the agents. Ede (2022) found that there is a high relationship between the extension delivery techniques and the extent at which farmers accept to use technology. In other words, the manner at which the message is communicated to the farmers to a great extent determines their level at which they would accept it (Samuel, 2018). Okey 2021 observed that the use of greenfield has improved farmers perception of the need for technology in their farming. Further, Akpaifai (2019) noted that mass media technique which is most reliable in reaching large audience has contributed to changing the orientation of farmers towards adoption of technology to a great extent. In the opinion of Ede (2022), small plot adoption technique SPAT rather serves a better approach for farmers to participate in the training which would lead to adoption of new farming innovation. Samuel (2018) found that the adoption of green field days technique has led to farmers acceptance of farm innovation to a high extent. In a study by Larry and Ben (2020), it was found that there is a high level of relationship between the adoption of mass media and rural literate farmers acceptance of new technology in farming. The authors attributed this relationship to the growing impact of media on both rural and urban people. Ottah (2019) noted that SPAT when well organized could convince farmers to a high extent to accept change in their farming system from manual to modern technology.
Modern agricultural technology according to Pansak, (2017) can substantially improve agricultural production on a sustainable basis. The author further stressed that, the best management practice is widely applied nowadays. This relies on use of machines in farming, targeting many of their applications, on new disease resistant hybrids, biological pest control, reduced pesticide use, cultural practices that can reduce the incidence of pests and diseases, better placement and reduced amounts of fertilizers are all being employed. (Nwaekpe *et at*, 2014) noted that one of the objectives of extension agents is

to strengthen indigenous capabilities for agricultural planning and project execution. Extension programme is accomplished through training of both staff for efficiency and farmers for awareness and for adoption of the improved farming technologies.

Extension services therefore are used to serve as a vehicle for conveying and educating farmers on the new agricultural policies and practices. Perhaps, for this to be optimally realized, well trained and articulated extension workers are needed to extending extension messages to wide range of farmers who live significantly in the rural areas (Tambari *et al.,* 2014). Adebo & Ewuola, (2006) added that for these farmers to improve their farming practices towards adopting new technologies or improved farming practices; certainly they require to be trained in order to use different extension methods. Agricultural technology has remained a viable tool for improving the productivity of the agricultural sector. Akudugu, Guo and Dadzie (2012) noted that helping farmers improve their yields requires a comprehensive approach that includes the use of seeds that are more resistant to disease, drought and flooding; information from local sources on more productive farming techniques and technologies; greater access to markets; and government policies that serve the interest of farming families.

The last two decades have witnessed the increasing importance of food production and consumption in Adamawa State. Since subsistence agriculture is practiced among farmers and have been characterized by a low level of resource utilization and low level capital investment. However, before the discovery of the crude oil in commercial quantity, agriculture was the main stay of the state's economy, sustaining and making agricultural technology useful to rural farmers would require a linkage or synergy with other close associates.

Consequently, there is need to improve the agricultural sector in the state against the much talked about food crises as well as to ensure the strategic engagement of the urban people of Adamawa State in food production because the importance of agriculture (food production), cannot be over-emphasized and this can only be achieved when there is proper integration of modern agricultural technologies in the farming process. Data from existing literatures showed that adoption of technology in developing countries has increased food production. Therefore, there is need to alleviate poverty, attain food security and to boost food production. It is against this background that the study is undertaken to examine the relationship between Agricultural Extension Delivery Techniques and adoption of modern farm technology in Adamawa state of Adamawa State.

Statement of the problem

Over the years, there have been a decline in food production in Adamawa State. This is not only attributed to lack of use of fertilizer but also a reduction in the adoption of proper Agricultural or farm technology. Unfortunately, most farmers do not have access to or utilize Agricultural technologies because they live in remote areas and as a result, they are not aware of the modern technologies, improved practices and methods being used to increase food production. Some farmers are still not current with the improved varieties adopted in the state and the disease control measures taken to increase crop yield.

However, from observation, the numbers of extension agents in Adamawa State are not adequate to the teaming population of farmers in the rural areas and the extension agents on their part seem not to give proper training to the farmers due to time constraint and other limiting factors. Hence, low yield is being recorded in their farms, as a result of not

utilizing required farm technologies. The record of farmers yield in the area shows that some farmers have high output while some record low output despite farming on soil with same fertility level. A face to face interaction with the farmers have also revealed that most farmers utilize different extension delivery techniques while many still does not. More so, some farmers seem to pay deaf ear to the use of modern farming technology while some others try all best to adapt to new innovations in their farming system. This situation cuts across all categories of farmers. It is therefore difficult to attribute the adoption of farm technology and record of high yield to extension technique the farmers adopt or other factors thus creating a research gap. It is on that ground that the researcher sought to determine if there is a relationship between the extension technique being exposed to the farmers and their adoption of sustainable farm technologies in Adamawa state.

Purpose of the study

The purpose of the study is to examine the relationship between Agricultural Extension communication techniques and adoption of modern farm technologies in Adamawa state, Adamawa State. Specifically, the study tends to:

1. determine the level of relationship between farmers exposure to mass media technique and adoption of farm technology.
2. find out the level of relationship between farmers exposure to green field delivery techniques and adoption of farm technology.
3. examine the level of relationship between farmers exposure to small spot delivery techniques and adoption of farm technology.

Research questions

The following research questions guided the study

1. What is the level of relationship between farmers exposure to mass media technique and adoption of farm technology?
2. What is the level of relationship between farmers exposure to green field delivery technique and adoption of farm technology?
3. What is the level of relationship between farmers exposure to small plot adoption technique and adoption of farm technology?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance

Ho_1: There is no significant relationship between level of exposure to mass media delivery techniques and adoption of farm technology

Ho_2: There is no significant relationship between level of exposure to green field days delivery techniques and adoption of farm technology

Ho_3: There is no significant relationship between level of exposure to small plot adoption delivery techniques and adoption of farm technology

Methodology

The study adopted correlation research design. This is concerned with assessing relationship between two or more phenomena. This study was carried out in Adamawa state of Adamawa State, located in North East Nigeria. The population of this study was 1389 farmers in Adamawa State. These farmers cuts across the different farming areas in the

state. Taro Yameni formula was used to draft 310 farmers from the entire population for use in the study. Simple random sampling was further used to sample 310 farmers across all the accessible local governments in the state. The instrument for the study were two sets of questionnaires developed by the researcher and titled, Agricultural Extension Delivery Techniques Questionnaire (AEDTQ) and Level of Agricultural Technology Adoption Questionnaire (LATAQ). The two instruments consist of two sections, A and B. Section A was mainly for collecting personal information of the respondents while section B was designed to gather data concerning Agricultural Extension Delivery Techniques and level of agricultural technology adoption in the study area. The two questionnaires were placed on a four-point rating scale. The instrument validated by three research experts in Agricultural Education Department, Joseph Sarwuan Tarka University, Makurdi. Each of the two instruments were administered once on 20 registered farmers in Gombe State. The data obtained were analyzed using Cronbach Alpha coefficient and a reliability of .77 and .73 were obtained for AEDTQ and LATAQ respectively which proves that the instruments are reliable for the study. 310 copies of the questionnaire were administered to the registered farmers with the help of 5 research assistance in the state. 289 copies (93%) of the questionnaire were retrieved and analyzed while 21 copies were lost. Pearson Product Moment (PPM) correlation was used to answer the research questions while linear regression was used to test hypotheses. The decision rule for the interpretation of correlation coefficient (r) value are as follows: $\pm$ 1.00 Perfect relationship, $\pm$ 0.70- 0.99 Strong/Very high relationships, $\pm$0.60- 0.69 High relationship, $\pm$ 0.50- 0.59 Moderate high relationship $\pm$ 0.30- 0.499 Weak/Low relationship, $\pm$ 0.10- 0.29 Very low relationship and $\pm$ 0.00 No relationship (Rumsey, 2016). For hypotheses testing, the null hypothesis was accepted if the p-value is equal to or less than the alpha value of 0.05 and vice visa

Results

Research question 1: What is the level of relationship between farmers exposure to mass media technique and technology adoption?

Table 1: Pearson Product Moment correlation result of the level of relationship between mass media delivery techniques and technology adoption.

S/n	Item	$\bar{X}$	*R*	Relationship
1	Mass media	2.84		Very high
			.89	Positive
2	Technology adoption	3.04		

$\bar{X}$- Mean, r- PPM calculated, r critical- correlation coefficient, level of significance - .05

Data in Table 1 above shows a correlation coefficient (r) of .89 which is within .77- .99, showing a very strong/ high positive correlation. This means that there is a very strong/high positive level of relationship between mass media delivery technique and adoption of farm technology

Research question 2: What is the level of relationship between farmers exposure to green field technique and technology adoption

Table 2: Pearson Product Moment correlation result of the level of relationship between green field delivery techniques and technology adoption

S/n	Item	$\bar{X}$	*R*	Relationship
1	Green Field	3.17		Very high
			.74	Positive
2	Technology adoption	3.04		

$\bar{X}$- Mean, r- PPM calculated, r critical- correlation coefficient, level of significance - .05

Data in Table 2 above shows a correlation coefficient (r) of .74 which is within .70- .99, proving a very strong/high positive correlation. This means that there is a very strong positive relationship between green field delivery technique and technology adoption by farmers

Research question 2: What is the level of relationship between farmers exposure to small plot adoption technique and technology adoption?

Table 3: Pearson Product Moment correlation result of the relationship between small plot adoption delivery techniques and technology adoption

S/n	Item	$\bar{X}$	*r*	Relationship
1	SPAT	2.92		Very high
			.810	Positive
2	Technology adoption	3.04		

$\bar{X}$- Mean, r- PPM calculated, r critical- correlation coefficient, level of significance - .05

Data in Table 3 above shows a correlation coefficient (r) of .81 which is within .77- .99, showing a very strong/high positive correlation. This means that there is a very strong/high positive relationship between small plot adoption delivery technique and technology adoption by farmers.

Hypothesis 1: There is no significant relationship between level of exposure to mass media delivery techniques and technology adoption

Table 4: Regression Analysis of the relationship between level of exposure to mass media delivery techniques and food production

Model	Sum of Squares	Df	Mean Square	F	p-value
Regression	.033	1	.033	.438	.509
Residual	27.410	282	.076		
Total	27.443	283			

Df= degree of freedom, F= F- calculated, correlation is significant at 0.05 level of significant (two tailed)

a. Dependent Variable: technology adoption

b. Predictors: (Constant), delivery technique (mass media delivery technique)

The result of the data presented in Table 4 above shows a p-value of .509 and is greater than the alpha value of .05 thereby rejecting the null hypothesis tested, this means that there is a significant relationship between mass media delivery technique and technology adoption by farmers

Hypothesis 2: There is no significant relationship between level of exposure to green field delivery techniques and technology adoption

Table 5: Regression Analysis of the relationship between level of exposure to green field delivery techniques and technology adoption

Model	Sum of Squares	Df	Mean Square	F	p-value
Regression	.038	1	.038	.427	.514
Residual	32.046	282	.089		
Total	32.084	283			

Df= degree of freedom, F= F- calculated, correlation is significant at 0.05 level of significant (two tailed)

a. Dependent Variable: technology adoption

b. Predictors: (Constant), delivery technique (green field delivery technique)

The result of the data presented in Table 5 above shows a p-value of .514 and is greater than the alpha value of .05 thereby rejecting the null hypothesis tested, this means that there is a significant relationship between green field delivery technique and technology adoption by farmers.

Hypothesis 3: There is no significant relationship between level of exposure to small plot adoption techniques and technology adoption

Table 6: Regression Analysis of the relationship between level of exposure to small plot adoption techniques and technology adoption

Model	Sum of Squares	Df	Mean Square	F	P-value.
Regression	.065	1	.065	.711	.400
Residual	32.875	282	.091		
Total	32.940	283			

Df= degree of freedom, F= F- calculated, correlation is significant at 0.05 level of significant (two tailed)

a. Dependent Variable: technology adoption

b. Predictors: (Constant), delivery technique (small plot adoption delivery technique)

The result of the data presented in Table 6 above shows a p-value of .400 and is greater than the alpha value of .05 thereby rejecting the null hypothesis tested, this means that

there is a significant relationship between small plot adoption technique and technology adoption by farmers.

Discussion of the findings

The findings of the study in research question 1 revealed that there is a very high level of relationship between mass media technique and farmers adoption of technology. This finding is in keeping with Akpaifai (2019) who noted that mass media technique which is the most reliable in reaching large audience has contributed to changing the orientation of farmers towards adoption of technology to a great extent. More so, the findings agrees with Larry and Ben (2020) who found that there is a high level of relationship between the adoption of mass media and rural literate farmers acceptance of new technology in farming. The findings of the study on hypothesis 1 is in line with Nazari and Hassan (2011) who found that there is a significant positive relationship between mass media extension delivery method and farmers technology adoption leading to increased food production rate

The findings of the study in research question 2 revealed that there is very high level of relationship between greenfield technique and farmers adoption of farm technology. This find is in line with Okey (2021) who found that the use of greenfield has improved farmers perception of the need for technology in their farming. In keeping with the findings also Samuel (2018) found that the adoption of green field days technique has led to farmers acceptance of farm innovation to a high extent. The findings of the study in hypothesis 2 is in keeping with Udoma (2013) who found that there is a significant positive correlation between green field extension delivery technique and food production among farmers.

The findings of the study in research question 3 revealed that there is a very high level of relationship between SPAT and farmers adoption of technology. This finding agrees with Ede (2022) who noted that SPAT rather serves a better approach for farmers to participate in the training which would lead to adoption of new farming innovation. The findings in hypothesis 3 is also in accordance with Ajayi and Fapojuwo (2013) who found that there is a significant correlation between SPAT and technology adoption by farmers.

Conclusion

Based on the result of the data collected, analyzed and findings made, the study concludes as follows. Farmers' awareness and utilization of the extension delivery techniques has improved their adoption of agricultural technology to increase food production to a very high level.

Recommendations

Based on the findings of this study, the following recommendations were made

1. Government through the extension agents should be encouraged to make policies and programs that will enable farmer to easily access information through mass media such as radio, televisions, newspapers social media etc. By allocating sufficient time for free radio and TV program aimed at reaching the rural farmers owing the role mass media delivery technique play in food production as found by this study.

2. Extension agents should ensure that they create conducive, adequate, and enabling environment for exhibitions during green field show so that farmers and other members of the public can be exposed to new agricultural products
3. Farmers should make available adequate spaces in their farm for be used to demonstrate innovations under the supervision of extension agents during small plot adoption technique
4. Farmers should adopt all the extension delivery techniques identified by this study as it has been found to lead to increased technology adoption and food production.

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