



Farmers' Usage of Agrochemicals in a Maize Based Multi Cropping System: A Case Study of Small Holder Farmers in Ifedore Local Government Area, Ondo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author JOO designed the study and author KEO performed the statistical analysis. Author JOO wrote the protocol and wrote the first draft of the manuscript. Author KEO managed literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The need to introduce farmers to new technologies in agricultural production cannot be over emphasized. This is because most of the farmers still utilize the traditional agricultural practices which affect their farm output. The study therefore examined the factors affecting the adoption of agrochemicals by maize farmers in Ifedore Local Government, Ondo state. One Hundred (100) maize farmers were randomly selected from the study area. Both primary and secondary data were used for the study. The primary data was collected with the use of pre-tested and validated questionnaires. Direct observation techniques and interview of key informants were also used to enrich the data collected. Descriptive statistics such as frequency counts, percentages and inferential statistics such as Chi Square, Pearson product correlation were used to analyze the primary data. The findings from the study showed that 74 percent were below 50 years, 88 percent

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of the respondents had formal education while only 12 had no formal education. The study showed that 50 percent of the farmers had been into farming for more than 10 years. Most of the respondents (89 percent) were small-scale farmers cultivating 0.1–2.9 hectares. The farmers practiced multiple cropping systems with maize as the predominant crop. About 94 percent planted maize with other crops while only 5 percent planted maize only. The result revealed that 76 percent of the respondents asserted that they never used fertilizers. The Extension personnel visited 64 percent of the farmers. The study showed a significant relationship between education and the usage of fertilizer but a non significant relationship between marital status, religion, age and family size and usage of fertilizer. It is recommended that farmers should be visited frequently by extension agents with the objective of disseminating information on new technologies to enhance their level of production.

Keywords: Agrochemicals; maize and multi cropping.

1. INTRODUCTION

Food production is very important to Nigerian economy. This is because; the rapid rate of population growth in the country which has been estimated at 3 percent annually has necessitated the need for increase food production to meet the demands of the increasing population. In the last decade Agricultural contribution to the country's Gross Domestic production declined from an average of 50.2 percent in 1960–1970 to 21.8 percent between 1976–1980, it increased to 39.6 percent in 1991–1995, 41.2 percent in 1986–1990, while it stabilized to an average of 40 percent in the 1990s and 41 percent in 2012. However, in recent time the performance of the agricultural sector improved, in 2003 a growth rate of about 6.1 percent was attained as an increase over 4 percent in 2002 and 5.6 percent in 1999–2002 period. The reason for the above, could not but be attributed to recent Federal Government and International Agencies Programmes such as the Fadama Development Programme (NFDP), special credit schemes, the IFAD–assisted Cassava Multiplication Programme, the National Japanese – Assisted rice Production Programme among others.

Despite these programmes, there is the need to introduce the farmers to new technologies in agricultural production. This is because most of the farmers still utilize the traditional agricultural practices which affect their farm output. The high yielding variety seeds, which have been introduced to enhance production and productivity in the agricultural sector, requires adequate nutrient, but the continuous exploitation of the soil in the past without adequate attention to the management of soil fertility and crop health has resulted in gradual exhaustion of plant nutrients, infestation of plants pests and diseases and loss of quantity and quality of produce. This

is still a major issue in Nigerian agricultural if adequate provision is not made for Agrochemical and fertilizers in food production, no matter the hybrid vigor of the seed or the planting technique used, maximum yield may not be achieved at the end of the task. With the introduction of modern agricultural production techniques and the adequate supply of plant nutrients (through the use of fertilizer) and sound soil management practices, the rate of food production can be enhanced and high rate of production can be sustained under heavy and continuous cropping situation.

Agrochemicals include chemicals, which enhance growth and yield of the crop and are specifically designed to combat attacks of various pests.

In view of the above it is imperative to consider the factors affecting the acceptance of the synthetic substances (agrochemicals) used in agricultural production to enhance its efficiency. This ranges from fertilizers to insecticides, fungicides, herbicides etc. The above is necessary not only because it enhances productivity and promote a conducive environment for healthy growth of crops [1,2] but also necessary to understand the extent to which the farmers are enlightened on the appropriate use of the agrochemical to minimize hazards and threat that inappropriate use could pose to both human health and the environment. This is because research has shown that Agrochemicals in farming must be appropriately used to avoid high level of residual effects of the chemicals in food substances [3,4]. The role of agricultural extension with respect to the above cannot be underscored; this is with respect to dissemination of appropriate information to the farmers on the use of the agrochemicals. It is also important to understand the factors that influence farmers'

rate of adoption of the new technology so as to enhance appropriate planning and implementation of policies.

The study therefore seeks to answer the following questions:

1. What are the types of agrochemicals being introduced to the farmers?
2. What are the farmers' sources of information on the use of agrochemicals?
3. To what extent has extension activities affected the farmers' rate of adoption of agrochemicals?
4. What are the factors influencing farmers acceptance of the innovation?
5. Has this new technology affected the farmers' level of production?

The general objective of the paper is to identify the factors affecting the adoption of agrochemicals by maize farmers in the study area: the specific objectives of the study were to:

1. Ascertain the socio economic characteristics of the respondents.
2. Examine the sources of information available to the farmers.
3. Determine the effect of extension visitation on farmers adoption of new technologies.
4. Determine socio-economic factors that affect adoption of technology by farmers.

1.1 Hypotheses of the Study

Ho₁: There is no significant relationship between the socio-economic characteristics of respondent and adoption of the use of Agro input.

Ho₂: There is no significant relationship between extension visitation and the adoption of Agrochemicals.

2. METHODOLOGY

The area of study is Ifedore Local Government Area of Ondo State. The study area is located in the rainforest belt of Nigeria with the climatic condition characterized by two distinct seasons. The rainy season is from March to October and dry season between November and February. The type of vegetation cover is rainforest type which makes the farmers to be involved in production of food crops like Yam, Maize, Cassava, Cocoa Yam and Cash crops like Cocoa, Oil palm and Kolanut. The people are

predominantly farmers practicing multiple cropping systems.

Ifedore Local Government area (LGA) was purposively chosen among the Local Government Area of Ondo State because of the intensive use of agrochemicals by maize farmers in the area. List of communities in the Local Government was collected from about twenty communities listed, five communities were randomly chosen, and each community was divided into four wards out of which two were randomly selected from each ward making a total of twenty respondents from a community and total samples size of one hundred. Both primary and secondary data were used for the study. The primary data was collected with the use of pre-tested and validated questionnaires. Direct observation techniques and interview of key informants were also used to enrich the data collected.

2.1 Method of Data Analysis

Descriptive statistics such as frequency counts percentages and inferential statistics such as Chi Square, Pearson product correlation were used to analyze the primary data. The statistical package for the social sciences (SPSS) software was used to analyse the data.

3. RESULTS AND DISCUSSION

The section discussed results of data analysis obtained from the study.

3.1 Socio- economic Characteristics of Respondents

Most of the respondents (31 percent) were in the middle age (41-50 years) while 25 percent were between 31–40 years as shown in Table 1. From Table 1, most of the respondents (74 percent) were still in their active years since they are below 50 years and are strong with vigor to be involved in agricultural production. From the results most of the farmers are young and this is a factor that can enhance their adoption of innovation. This is because the rate of adoption is high among the youths than the older people, because they are more willing to take risk and try out new techniques. Seventy two percent of the respondents do not have formal education, 29 percent had tertiary education and 35 percent attained secondary school education. This is a factor that could aid adoption of innovation by the

respondents because studies by [5-7], have shown that education influences adoption of innovation because it gives the farmer opportunity to obtain information from many sources since he could read and write.

Table 1 also showed that 36 percent of the farmers had been into farming for 6–10 years, 27 percent for over 21 years while 14 percent have been into farming for 11–15 years and 16–20 years respectively. The results showed that most of the respondents had adequate farming experience and could easily analyze and take decision on whatever technology being introduced to them. Most of the respondents (89 percent) are small-scale farmers cultivating 0.1 – 2.9 hectares according to [8] classification, due to their small holdings they may find it difficult to take risks by accepting new technology, thus, they prefer to stick to their known old methods.

3.2 Respondents Type of Farming Systems and Purpose of Maize Cultivation

In the area of study the farmers practice multiple cropping systems with maize as the predominant crop. About 94 percent planted maize with other crops while only 5 percent planted maize only as shown in Fig. 1. From Fig. 1, the reason why maize was a predominant crop could be because it takes a shorter period of about 3 months to produce and it could be easily intercropped with other crop, most specifically tuber crops. Most of the farmers (59 percent) cultivate maize for family consumption and sales. Maize is processed into different forms of which are consumed by the farmers; it is also used for commercial production of animal feed. This serves as additional source of income for the family hence the response of 33 percent of the farmers that they cultivate maize for commercial purposes.

3.3 Use of Agro Chemicals and Fertilizers

About 14 percent of the respondents asserted that they never use fertilizers while 50 percent use fertilizer regularly and 26 percent occasionally as shown in Fig. 2. The figure revealed that 62 percent use Agrochemicals regularly while 28 percent utilize it occasionally and 10 percent never use it. The reason why some of the farmers may not have used or be using fertilizer and agrochemical could be because they could not afford the cost to purchase and in some cases if the soil could still

be fertile most especially if it is land that has just been newly cultivated. The type of fertilizers and agrochemicals are shown in Table 2.

Table 1. Respondents' personal characteristics

	Variable	Percentage
i.	Age	
	20 – 30	18.0
	31 – 40	25.0
	41 – 50	31.0
	51 – 60	18.0
	61 and above	8.0
ii.	Marital status	
	Married	72.0
	Single	23.0
	Divorced	3.0
	Widowed	2.0
iii.	Religion	
	Christianity	79.0
	Islam	16.0
	Traditionalists	5.0
iv.	Educational level	
	No Formal Education	12.0
	Primary Education	35.0
	Secondary School	14.0
	Diploma	29.0
	Tertiary Education	
v.	Farming Experience	
	1 – 5 years	36.0
	6 – 10 years	14.0
	11 – 15 years	14.0
	16 – 20 years	27.0
	21 years and above	
vi.	Farm size	
	0.1 – 2.9 Ha	89.0
	2.10 – 4.99 Ha	6.0
	5.0 ha and above	5.0

Table 2 has shown that 48 percent of the respondents use inorganic fertilizers such as N.P.K 15:15:15 and urea only on their farm, 44 percent use organic fertilizers such as compost etc. while 8 percent used both. The reason why most of the farmers do not use inorganic fertilizer could be because of the cost. Most of the farmers as stated earlier are small scale farmers with low income as such may not be able to afford the cost of the fertilizers, hence they may have resulted into the use of organic fertilizer to replenish their soil fertility.

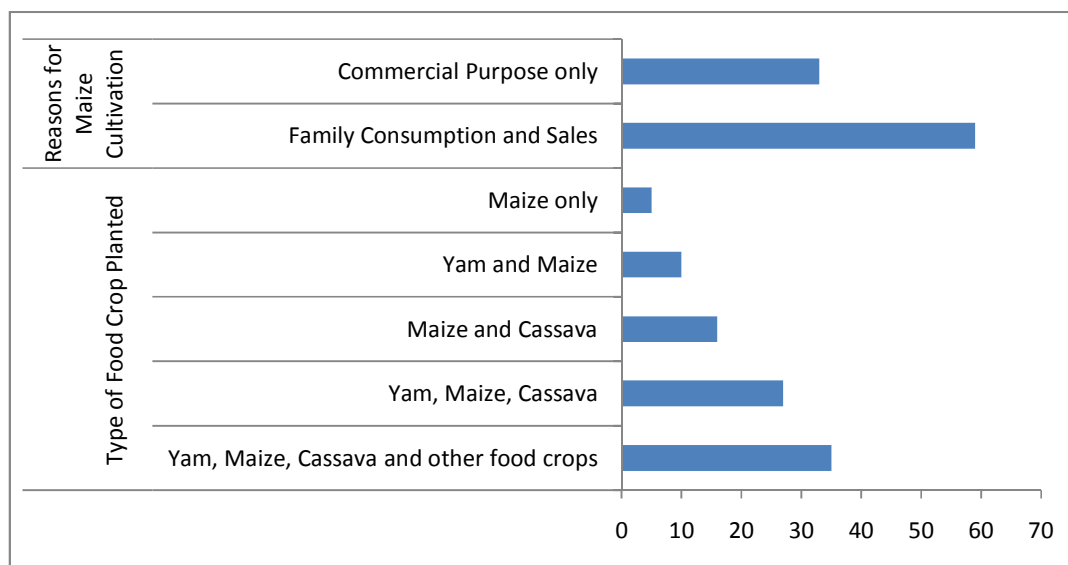


Fig. 1. Respondents type and purpose of maize cultivation

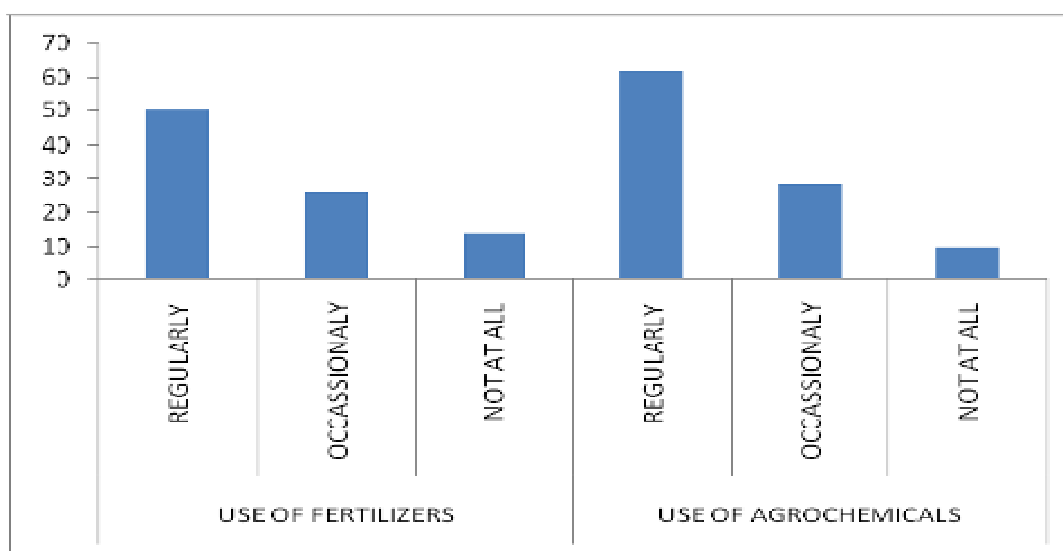


Fig. 2. Use of fertilizers and agrochemicals

3.4 Type of Fertilizers and Agrochemicals Used by Respondents

During discussion with some of the key informants, it was realized that some of the respondents do not use inorganic fertilizers because they do not have access to it and at times when they have access to it, they do not get it when it is required. Thirty-two percent of the farmers apply agrochemicals at most 2 times per season, 11 percent 3–4 times and 19 percent above 4 times in a season. Application of agrochemicals depends on type of Agrochemical

but from the table most of the farmers apply insecticides, this shows that the insect threshold level is low in most of the farms more so it is maize based, however, in farms where it is applied more than 4 times it has serious cost implication on the farmers. Fifty two percent of the farmers also apply less than 10 litres per year. This could be because they farmers are small holder farmers, since farm size and threshold level of pests and diseases determine the quality of Agrochemicals usage.

On the use of Agrochemicals, 33 percent utilize insecticides, only 8 percent combine the use of

insecticides and herbicides, and insecticides and fungicides respectively. However, 38 percent do not use agrochemicals. The reason why they do not use agrochemicals could be because they could not afford the cost and also non availability when it is required. The result implied that very few of the farmers use agrochemicals to control weed on their farms thus showing that they utilize mostly manual labour which may not be readily available and may not be effective. Most of the farmers (39 percent) were aware of the use of agrochemical and fertilizers through agricultural extension agents as shown in Fig. 3.

3.5 Respondents' Sources of Awareness

Fig. 3 shows that 35 percent of the farmers knew about agro-chemical and fertilizers through the extension agents while 34 percent got the information from mass media programmes. The reason for the above could be because the extension agents visits the farmers and are trained to disseminate information on innovation to farmers and also help them to acquire the necessary skills for its usage. Most extension visitation to the farmers is also fortnight, as revealed in Table 3.

Table 2. Type of fertilizers and agrochemicals used by respondents

A	Type of Fertilizer	Percentage
	Inorganic Fertilizers only	48
	Organic fertilizer only	44
	Both organic and inorganic	8
B	Type of Agrochemicals	
	Insecticides only	33
	Insecticides and herbicides	8.0
	Insecticides and fungicides	8.0
	Fungicides only	7.0
	Herbicides only	3.0
	All of the above	3.0
	None of the above	38.0
C	Number of Agrochemical application per season	
	Zero	38
	1-2	32
	3-4	11
	4 and above	19
D	Average Quantity of Agro chemicals used (Litres)	
	1 – 10	52
	11 – 20	41
	20 and above	7

Table 3. Extension visitation and innovations introduced to farmers

	Variable	Percentage
a.	Contact with the farmers	
	Fortnightly	59
	Monthly	15
	Quarterly	5
	None	21
b.	Types of innovation introduced to farmers	
	Use of fertilizers and Agrochemicals	60*
	Management Techniques	53*
	Improved Crop Varieties	44*
	Storage processing methods	25*

*Multiple Responses

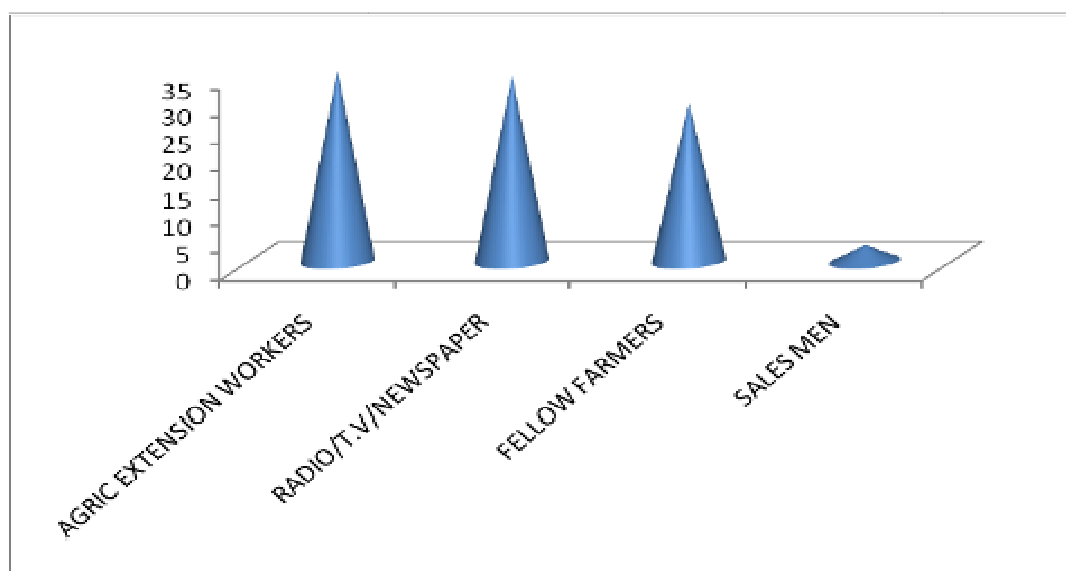


Fig. 3. Respondents' sources of awareness

The Extension personnel visit most of the farmers (59 percent) fortnightly, 15 percent monthly and 21 percent quarterly. The result supports [5] report that under the Training and Visit (T & V) system, the extension agent visits the farmers fortnightly to disseminate impart points to them and get feedback from the farmers. The result confirmed that the extension agents to a greater extent were practicing the T & V system as expected. This is because Ondo State ADP is still using T & V system of extension. Sixty percent of the farmers also stated that they introduced use of Agrochemicals and Fertilizer to them. This is expected to enhance their adoption of the innovation.

3.6 Sources of Agrochemicals and Fertilizers to Farmers

Twenty-four percent of the respondents obtained their inputs from government selling point and private vendors as shown in Table 4. Findings also revealed that the farmers obtained the stated farm inputs from Government Agencies (24 percent) which include Agricultural Input supply companies and private vendors (24 percent). About 10 percent obtained agrochemicals and Fertilizers from cooperative societies while 27 percent do not purchase the items at all. The implication of the above is that farmers have access to farm input from different sources and as such should not have problems in obtaining the goods for their farm. However, the respondents agreed that the cost of

procurement affected the quantity of fertilizers being utilized on their farm as shown in Table 5.

3.7 Socio-economic Factors Affecting Adoption of Technology by Farmers

Table 5 has shown that 58 percent of the respondents agreed that cost of procurement influence the quantity of fertilizer they use on their farm. This could be because most of them have small farm holdings and low income, thus limiting the quantity of fertilizer they could afford. Similarly, 75 percent of the farmers agreed that cost of procurement affect the quantity of agrochemicals they acquire. The result confirms [9], assertion that the cost of any (new) technology affects its adoption by farmers; this because once the cost is not economically feasible farmers will not accept it.

Thirty-two percent of the farmers could not decide the effect of distance on their use of fertilizer however, 25 percent agreed that it affects their use of the inputs while 24 percent disagreed with 16 percent stating that they strongly disagreed with the statement. This shows that to a great extent farm distance from selling point is not a hindrance to fertilizer use and agrochemical. Contact of farmers with the extension influenced the use of these farm inputs. Forty percent of the respondents agreed to this fact, 13 percent strongly agreed while 5 disagreed and 4 strongly disagreed. The basic responsibility of extension agent is to

disseminate information and train farmers on new technologies. Therefore, the response of the farmers confirms the effectiveness of extension activities in this area, although 38 percent were undecided which are those that could be late adopters and laggards who takes a longer time or never adopt new technologies, [10] categorized adopters to categories with late majorly/adopters and laggards in the last categories hence the result confirms the researchers classification. The respondents also asserted that the use of these farm inputs (Agrochemicals and Fertilizers) increased their farm outputs. This could be because education does not only give them opportunity to obtain information from various sources but also gives the ability to process such information. The result

confirms [11] assertion that education influences adoption of new technology.

The farm size of respondents also affects their use of fertilizer and Agrochemicals. Sixty-three percent of the respondents disagreed that it does not influence their farm size. The reason could be because their level of income is affected by their farm size thus, there is a limit to, the quantity of input they could use. The study also revealed that untimely supply of farm input affect their use of Agrochemical and Fertilizer (50 percent agreed and 5 percent disagreed). This could be because agricultural production is time bound hence, if these inputs are not available as at when required, it may not be useful to the farmers for the period.

Table 4. Sources of agrochemicals and fertilizers to respondents

	Sources	Percentage
i.	Government Agencies	24
ii.	Private Agencies	24
iii.	Cooperative Societies	10
iv	Government and Crop Societies	1
v.	Government and Private Vendors	9
vi.	Cooperative Societies and Private Vendor	5
vii.	Do not purchase at all	27

Table 5. Socio-economic factors affecting adoption of technology by farmers

S/N	Statement	Scores				
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	Cost of procurement of fertilizer affects the quantity being used on the farm	34	58	4	3	1
2.	Cost of procurement of Agrochemicals affects its use on the farm	12	75	8	4	1
3.	Farm distance to selling point affects the use of fertilizer	3	25	32	24	16
4.	Farm distance to selling point affect the use of Agrochemicals	4	11	31	47	7
5.	Contact with extension agent influenced the use of farm input (fertilizer and agrochemical)	13	40	38	5	4
6.	Use of agrochemicals fertilizer increased my farm output	16	40	42	1	1
7.	Untimely supply of the farm inputs (Fertilizer and Agrochemicals)	11	39	45	2	3
8.	Level of Education influencing my use of fertilizer and Agrochemicals	19	47	21	11	2
9.	My farm size does not influence my use of fertilizer and Agrochemicals	24	1	13	63	0

3.8 Test of Hypotheses

HO₁: There is no significant relationship between socio-economic characteristics of respondents and the usage of fertilizer.

The Table 6 revealed that only education influences the usage of fertilizer, others, marital status, religion, age and family size were not significant. This could be because both married, divorced and singles use fertilizer. Education influences the usage of fertilizer because it could allow the respondents know when, and how to use the products since he/she has access to various sources.

Table 6. Relationship between respondents' socio-economic characteristics and use of fertilizer

Socio economic characteristics	Cal X ²	Tab X ²	Df	Decision
Age	8.78		5	N.S
Marital Status	6.77	7.65	3	N.S
Religion	1.65	5.89	2	N.S
Education	22.54	12.59	6	S
Farm Size	0.34	5.89	2	N.S

HO₂: From Table 7 there was a significant association between educational level, farm size of respondents and their use of Agrochemicals.

This shows that Age, Marital Status, Religion does not influence the use of agrochemicals. The reason for the above could be because farm size influences the quantity of agrochemicals to be used and this has implication on the cost of procurement. Most large farmers also find it economical to use agrochemicals for weed and pest control while smallholder farmer may find it difficult to use agrochemicals and the use of the stated inputs.

Table 7. Relationship between socio-economic characteristics of respondents and use of agrochemicals

Socio-economic characteristics	Cal X ²	Tab X ²	Df	Decision
Age	28.78	-	5	N.S
Marital Status	10.50	9.59	4	S
Religion	0.959	9.48	4	N.S
Education	15.64	12.59	6	S
Farm Size	19.74	9.48	4	S

HO₃: There is no significant relationship between extension visitation and adoption of innovation (Fertilizer & Agrochemical).

Table 8 showed that extension activities influenced the respondents' use of fertilizer and agrochemicals. This could be because with extension visit, farmers are educated and trained on the use of these agro-chemical and fertilizer.

Table 8. Chi square analysis of association between contacts with extension services and adoption of innovation

Visit by	Cal	X ²	Df	Decision
Agric extension agents	34.5	15.07	8	S.

4. CONCLUSION AND RECOMMENDATIONS

The study has shown that most of the respondents are smallholder farmers who are between 31-40 years. The farmers utilize mostly pesticides on their farms while they use both organic and inorganic fertilizers. It is important to note that cost of input affects the use of fertilizers and agrochemicals; however the farmers asserted that the use of these inputs affects their level of production. Education, farm size and marital status influence the use of the farm inputs. It is important that adequate effort should be made to ensure that the farmers have access to these farm inputs so as to increase their level of production. In view of the findings from the study, it is important that extension agents should visit farmers frequently with well-defined impact points on the use of agrochemicals and other related inputs so as to disseminate information to them about new technologies and innovations to them. New technologies and innovations should be designed and packaged by scientists, policy makers and extension agents in a way that farmers will be able to adopt and use them.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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