SOCIO-ECONOMIC FACTORS INFLUENCING THE UTILIZATION OF AGROCHEMICAL PRACTICES BY COWPEA (*Vigna unguiculata*Walp) FARMERS IN HONG LOCAL GOVERNMENT AREA OF ADAMAWA STATE.

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ABSTRACT

The study analyzed factors influencing the utilization of agro-chemical practices by cowpea (Vigna unguiculataWalp) farmers in Hong Local Government Area of Adamawa state, Nigeria. The study described the socio-economic characteristics of the respondents, identified utilization of recommended practices in use of agrochemicals, determines the factors influencing the utilization of recommended practices. Primary data were randomly collected through questionnaires from 144 farmers. Data generated were analyzed using descriptive statistics and multiple regression analysis. The major findings revealed that 53.5% of respondents were female, 43% were within the ages of 31-40 years, 47.9% were married, 52.1% had household size of 1-5 individuals with mean of 8. Similarly, 35.5% had National Diploma/NCE educational level, 47.9% had farming experience of 1-10 years with mean of 12.26, 52.8% acquired their farm land through inheritance and 53.5% had agriculture as their primary occupation. Furthermore 60.4% of respondents do not have access to credit, 93.7% do not have access to extension, and while 47.9% had annual farm income of N50, 000-99,000 with mean income of N101, 211.78. The results further revealed that less than 40% of respondents actually made use of recommended agrochemical practices. The coefficient of multiple determinations R^2 from regression analysis revealed that 79.77% of the variation in percentage utilization of recommended agrochemical practices were explained by the variable included in the models. Age, household size, education, farm size, farm income, agrochemical usage and number of extension visits were significant. The study therefore recommended that field training and practical education to respondents by extension agent, radio and television progarmmes in local language, provision to loan and credit to farmers, provision of basic infrastructures as well as subsidizing the cost of radio/TV centres were made so that farmers can have free flow of information on agro-chemical usage.

Keywords: Factors, utilization, agrochemical, cowpea farmers, influence, Hong and Adamawa State.

INTRODUCTION

There is a need   for a valid research on the farmers's level of awareness and utilization of recommended agrochemical practices in Nigeria particularly cowpea farmers . Awareness, information and innovation which are intended to improve agricultural production especially cowpea production should be disseminated to farmers and ultimately meet their needs. Adequate knowledge about the toxicities of pesticide products and the adoption of best practices in pesticide use is of prime importance to avoid poisoning, reduce pesticide residues in food and ensure environmental safety. Frequent exposure to pesticides by traders can cause both acute and chronic health complications such as skin dermatitis, respiratory disorders, neurologic disorders, cancer and death (Erhunmwunse, N., Dirisu, A. and Olomukoro, J 2012). Awareness and skills regarding safe and efficient application of pesticides are not adequate at farmers' level, exposing them to risk of pesticide poisoning (Diwakar, J., Prasai, T., Pant, SR., and Jayana, BL., 2008).

The use of agrochemicals helps improve farm work productivity and efficiency in addition to promoting the quick and healthy growth of crops and animals. The use of agrochemicals in agricultural production has numerous significant advantages and has significantly increased the availability of food; without agrochemicals, food would be more expensive because it would necessitate more labour-intensive practises and competent management. (Muller, 2000; (Okori,.P., Rubaihayo.P.R., Adipala.E.,,Fahlesion, J.& Dixelium,C. 2004). The direct application of pesticides with total disregard, and in most cases, ignorance of the potential of poisoning from pesticides and their residues in food have been observed in grain merchants and vegetable traders (Hassan and Charchar 2018; (Dahiru, B., Abdullahi, G. and Bukar, N. 2014); (Karunamoorthi, K., Mohammed, A. and Jemal, Z. 2011) . However, cowpea production

and storage are greatly threatened by severe insect pest infestation, leading to damage to stored produce and reduced profits for farmers and traders (Dahiru *et al.*, 2014).

All over the world, the misuse of pesticide in farm business has often been associated with health problems and environmental contamination (Remor, A.P; Totti. C.C; Moreira, D.A; Dutra, G.P; Heuser, V.D & Boeira, J.M. , 2009). Misuse of highly toxic pesticides, alongside absent or unenforced legislative framework in the use of pesticides, is a major reason for high incidence of pesticide poisoning in developing countries (Konradsen, F.Hoek, W; Cole, D. C.; Hutchinson, G; Daisley, H; Singh, S; & Eddleston, 2003) Several other factors, including the emergence of new pests and diseases, a desire for higher yields, larger farm sizes, and environmental challenges account for increased use of agrochemicals. It is reported that pest and disease outbreak can decrease crop yield by 40%.15 Conversely, appropriate application of agrochemicals can increase crop yields significantly,29,30 a return that encourages more farmers to use agrochemicals.

Despite these efforts, recommended pesticides practices (such as appropriate application techniques, the use of genuine products, proper calibration of equipment, ensuring personal health and safety, and environmental safety) have been poorly adopted, resulting in pesticide failure, environmental hazards, and health hazards (Olowogbon, T. S., Fakayode, S. B., Jolaiya, A. J. and Oke, A. O. ,2013). Factors such as balanced use, optimum dosing, correct application method and timing helps in ensuring improved agricultural productivity (Bhan, 2014).

Cowpea (*Vigna unguiculata*) is a native legume to sub-Saharan Africa and it is mostly grown in the dry savanna region as an intercrop with crops like sorghum, maize, millet, and groundnut. Cowpea is an important source of protein, and it is consumed in different forms in various parts of the tropics. It plays a major role

in begetting income and ensuring food security for many small-scale producers (Abadassi, 2015).

Nigeria is the both largest producer and consumer of cowpea in the world, accounting for about 45 percent of the world's cowpea production. Out of the various legumes available in Nigeria, cowpeas are the most widely grown, traded and distributed food commodity (Akah, N.P., Kunyanga, C.N., Okoth, M.W. and Njue, L.K, 2021)). Despite the large production of cowpea in the country, there is still a challenge of postharvest losses.

Bourguet and Guillemaud (2016) reported that over the cowpea production countries, most especially over the past two decades there was increase in pesticide usage and it is widely acknowledged as the most effective method of controlling pest. The worry is what techniques, what quantity and how do these farmers apply these pesticides. Bourguet and Guillemaud (2016) reported that excessive use of pesticide not only kills pests but can also damage crops and other associated health hazards to humans. Karungi, J., Kyamanywa, S., and Adipala, E.,2011 apprises that indiscriminate and/or inappropriate pesticide use does not target the pests effectively and thus fails to minimize crop damage and causes health hazard to farmers and environment. Given the critical importance of cowpea both as food and cash crop, persistent loss in yield aggravates the food insecurity status of residents' cowpea-producing households and put at risk their ability to generate income through crop commercialization.

With this background thus, the need to explore farmer's awarenes and utilization of recommended agrochemical practices becomes imperative. Hence, the study exermined the awareness and utilization of recommended agrochemical practices among cowpea farmers in Hong Local Government Area of Adamawa State, Nigeria.

Objectives of the Study

The general objective of the study is to analyse the awareness and utilization of recommended agrochemical practices by cowpea farmers in Hong Local Government Area of Adamawa State. The specific objectives are to:

1. Describe the socio-economic characteristics of the respondents.
2. To assess the utilization of recommended practices in use of agrochemicals.
3. Determines the factors influencing the utilization of recommended practices.

The Study Area

The study was conducted in Hong Local Government Area of Adamawa State, Nigeria. It is one of the 21 Local Government areas of the State located in the central senatorial district and lies between Latitude $10^0 13'$ to $10^0 54'$N and Longitude $12^0 55'$ to $12^0 49'$E (Adebayo et al., 2020). The Local Government has a total land area of about 2,376.66 km² and a current (2021) projected population of 255,812 people, based on 2006 census 169,183 people (NPC, 2006). The dominant soil types in the area are luvisols, regosols, cambisols, vertisols and lithosols derived from basement complex, while few other places are on sandstones, shales and alluvium. The mean annual rainfall pattern shows that the amounts range from 700mm to 1000mm (Adebayo and Tukur, 1999). The temperature characteristic in the area is typical of the West African Savannah climate characterized by high temperature almost throughout the year due to high solar radiation which is relatively evenly distributed throughout the year. Maximum temperature can reach 40^0C particularly April, while minimum temperature can be as low as 18^0C between December and January. Mean monthly temperature ranges from 26.7^0C to 27.8^0C.

Major economic activity in the area is farming. Food crops grown include; maize, sorghum and cassava, while cash crops such as groundnuts, cowpea, cotton and sugar cane are produced in

large quantities. Some Livestock reared in the area are cattle, sheep, pigs and goats. The major ethnic group of the inhabitants is Kilba, while Margi, Higgi, Bura, Fulani and Hausa are the minority ethnic groups. The Local Government has seven (7) districts namely; Pella, Gaya, Uba, Dugwaba, Kulinyi, Hildi and Hong.

Sampling Technique and Sample Size
Four out of 23 extension cells in districts were randomly selected based on high concentration of cowpea producers in the areas (Table 1). The list of the 252 cowpea producers which was obtained through a pre-survey conducted in the study area was used as sampling frame. A total of 155 farmers were purposely selected proportionate to the number of farmers from each of the four cells in the districts using Taro Yamane's formula as adopted by Kalpana (2011). However, 144 respondents were collected and used for data analysis.

The formula is expressed as;

$$n = \frac{N}{1+N(e)2}$$

Where;

n = number of farmers;

N = population of the study;
e = error (5%)

Table 1: Target Population and Sample Size

S/N	Block	Cells	No. farmers (sampling frame)	No. of farmers selected
1	A block	Kwambola	52	32
		Pella	63	39
		Bangshika		
		Mombol		
		Kala'a		
		Hong		
		Neddeh		
		Zhedenyi		
2	B block	Shangui		
		Makera		
		Garaha		
		Mubula		
		Gaya		
		Mutuku	72	44
		Duwa		
		Kinging		
		Uba		
3	C Block	Hilda	65	40
		Mararaba		
		Kwarhi		
		Gashala		
		Njairi		
		Mayolope		
Total			252	155

Source: Pre-Field Survey, 2019.

Table 2: Target Population and Sample Size

S/N	Block	Cells	No. farmers (sampling frame)	No. of farmers selected
1	A block	Kwambola	52	32
		Pella	63	39
		Bangshika		
		Mombol		
		Kala'a		
		Hong		
		Neddeh		
		Zhedenyi		
2	B block	Shangui		
		Makera		
		Garaha		
		Mubula		
		Gaya		
		Mutuku	72	44
		Duwa		
		Kinging		
		Uba		
3		Hilda	65	40
		Mararaba		
		Kwarhi		
		Gashala		
		Njairi		
		Mayolope		
Total			252	155

Source: Pre-Field Survey, 2019.

Method of data collection

Primary data were obtained by the used of questionnaire. Data on socio-economic characteristics such as age, gender, marital status, farming experience, farm size, household size as well as utilization of agro-chemicals used, health hazards symptoms associated with agrochemicals usage used by farmers before agrochemical application were collected to achieve the study's objectives. Data were collected from August to September, 2021

Methods of Data Analysis

Descriptive and inferential statistics were used to analyze the data. Descriptive statistics were used to analyse objectives (i), (ii) while Multiple Regression was used to analyse objective (iii). Data was analysed using STATA 14. The explicitly form of the formula was expressed as follows;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 - \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu$$

Where

Y_i = Utilization of recommended practices (Percentage of the recommended practices utilized)

X_1 = Age (years)

X_2 = Gender (male=1: female=0)
X_3 = Household Size (Number of people)
X_4 = Education Level (Number of years spent in school)
X_5 = Farm Size (Hectares)
X_6 = Farming Experience (Years)
X7 = Access to credit (yes=1 or otherwise 0)
X_8 = Income from last season harvest (₦)
X_9 = Agro-chemicals used (Litres)
X_{10} = Number of extension visit (number)
n = Sample Size

RESULT AND DISCUSSION

Table 3: Distribution of Respondents based on their socio-enomics characteristic

A. Gender	Frequency	Percentage	Mean
Male	67	46.5	
Female	77	53.5	
Total	**144**	**100.00**	
B. Age (years)			
20-30	22	15.30	
31-40	62	43.00	
41-50	25	17.40	43
51-60	13	9.00	
61- & above	22	15.30	
Total	**144**	**100.00**	
C. Marital Status			
Married	69	47.90	
Single	52	36.10	
Divorced	23	16.00	
Total	**144**	**100.00**	
E. Household Size			
1-5	75	52.10	
6-10	36	25.00	
11-15	22	15.30	**8**
16 and above	11	7.60	
Total	**144**	**100.00**	
F. Farming Experience			
1-10	69	47.9	
11-20years	49	34.10	
21-30 years	12	8.30	**12.26**
31-40 years	14	9.70	
Total	**144**	**100.00**	
G. Educational Level			
Non formal	12	9.70	
Primary school	16	11.10	
Secondary school	19	13.20	
Diploma/NCEs	54	35.50	
Degree	31	21.50	
Postgraduate	12	9.70	
Total	**144**	**100.00**	
H. Primary Occupation			

Farming	77	53.50	
Artisan	23	16.00	
Trading/ business	44	30.60	
Total	**144**	**100.00**	
I. Secondar Occupation			
Farming	66	45.80	
Artisan	35	24.30	
Trading/ business	12	8.30	
Civil servant	22	15.30	
Student	9	6.30	
Total	**144**	**100.00**	
J. Farm size			
0.1-1	53	36.80	
1.1-2	76	52.80	
2.1-3	1	0.70	**1.83**
3.1-4	14	9.70	
Total	**144**	**100.00**	
K. Source of Credit			
Commercial bank	14	9,70	
Agric bank	11	7.60	
Friends	21	14.60	
Family	11	7.60	
No	87	60.40	
Total	**144**	**100.00**	
L. Annual Farm Income			
Less than 50,000	16	11.10	
50,000-99,000	69	47.90	
100,000-199,000	45	31.30	**101,277,78**
200,000& above	14	9.70	
Total	**144**	**100.00**	
N. Land Ownership			
Inheritance	76	52.80	
Rent	45	31.30	
Communal	11	7.60	
Purchase	12	8.30	
Total	**144**	**100.00**	

Sex of the Respondents

The sex of the respondents revealed that 46.5% were male while 53.5% were female. The result revealed more than half (53.5%) of the cowpea farmers in the study area were female. This shows that cowpea production in Hong Local Government Area of Adamawa State is determined by female. This finding was contrary to that of Bashir *et al.* (2018) who reported domination of male in cowpea production in a study conducted in Taraba State Nigeria. This could be because of the use of agrochemical is energy and time demanding therefore, can be done more effectively by male than females.

Age of the Respondents

Analysis of age of respondents in Table 3 showed that the mean age was 43 years which is an indicative of relatively equal age group among cowpea farmers in the study area. This shows that most respondents were within the youthful age and were considered agile and more likely to adopt modern production

practices.This agrees with the findings of Simon, N., Moses. J. D., Zalkuwi., and Medugu, A. J (2015) who found that most cowpea farmers in Gombi Local Government Area, Adamawa State, Nigeria were in their active age and this has positive bearing on cowpea productivity.

Marital Status of Respondents
Marital status distribution of the respondents in Table indicated that 36.10% were single, 47.9% were married, while 16% are divorced. This indicated that most of the respondents in the study area were married and the implication of this could be resultant pooling of idea together that could enhance cowpea production. The result collaborated the findings of Bashir *et al.* (2018) who reported high participation of married individuals in cowpea production and could enhance the availability of family labour among farmer in the study area

Household Size of Respondents
The household size distribution of the respondents in Table 3 revealed that 52.1% have family size of 1-5 persons, 25% have 6-10 persons, 15.3% have 11-15 persons, while 7.60% have 16 persons or more in their household. The mean household size was 8. This shows that household size of the respondents was not evenly distributed among the respondents and varies from largest to lowest. Large family size could implyed adequate labour supply for farm work and other activities like the use of herbicide. This agrees with the findings of Sani, L., Boadi, B. Y, Oladokun, O. and Kalusopa, T. (2014) who reported large household size among cowpea farmers in Kano State emanating from an extended family system practice by the people where parents and other relatives dwell together in a single compound.

Educational Status of Respondents
The level of education of the respondents in Table 3 revealed that 9.7% of the respondents have non-formal education, 11.1% have primary education, 13.20% have secondary education, 355% have National Diploma (ND)/ National Certificate in Education (NCE), 21.5% have University degree, while 9.7% have postgraduate education. This shows that over 90% of the respondents have attended one form of formal education or the other and are literate. This agreed with the findings of Abdullahi and Tsowa (2014) who stressed that cowpea farmers in Niger state are literate and are likely to raise their productivity through wise use of resources and will ease adoption of technology.

Farming Experience of Respondents
The farming experience of the respondents in Table 3 shows that 47.9% have 1-10 years' experience in cowpea production, 34.10% have 11-20 years, 8.30% have 21-30 years, while 9.7% have 31-40 years. The mean farming experience was 12.26 years. This shows most of the farmers in the study area have reasonably years of experience which will enable them acquire more knowledge on techniques involves for successful cowpea farming and the use of herbicide. This agreed with the study of Sani *et al.* (2014) who reported that long farming experience is an advantage for increasing farm productivity since it encourages adoption of new practices.

Land Ownership
Land ownership distribution of respondents in Table 3 revealed that 52.8% owned their land through inheritance, 31.3% through rent, 7.6% through communal system of ownership, while 8.3% was through purchase. This shows that majority (52.8%) of land ownership for cowpea production by the respondents was through inheritance. This type of ownership will encourage fragmentations that will lead to small scale farming.

Primary Occupation

The primary occupation of the respondents in Table 3 revealed that 53.5% were into farming, 16% were Artisan/technician, while 30.6% were into trading/business. This shows farming is the major occupation in the study area. This agrees with the finding of Zalkuwi, J., Maurice, D. C and Yusuf, C. (2014) who reported that majority of the respondents in north eastern Nigeria are into agricultural production due to limited opportunities in other sectors of the economy.

Secondary Occupation

Secondary occupation distribution of the respondents in Table 3 indicated that 45.8% supplement their earning through farming, 24.3% were artisan/technicians, 15.3% were civil servant, while 6.3% were students. This shows that agriculture still offers opportunity to most of the respondents as pointed out by Zalkuwi *et al.* (2014). Wakili (2013) further pointed out that majority of farmers in Adamawa state have diversified their incomes away from farming and are likely to make additional incomes to cater for their family upkeep and farm operation.

Farm size of Respondents

The farm size for cowpea production by the respondents in Table 3 revealed that 36.8% have farm size of 0.1-1 ha, 52.8% have 1.1-2ha, 0.7% have 2.1-3 ha, while 9.7% have 3.1-4ha. The mean farm size of the respondents was 1.83. This shows the majority (89.6%) of the respondents are operating on a farm between 0.1-2ha of land producing with little marketable surpluses. This agrees with the findings of Simon *et al.* (2015) who found that most farmers in Gombi Local Government Area of Adamawa state are still small-scale farmers.

Credit of Respondents

Credit serves as incentive to agricultural production. The result of the access to credit of the respondents indicated that 39.6% of the respondents have access to farm credit while 60.4% do not. This shows that most respondents do not have access to farm credit and could be the reason to low cultivable farm size because farmers need support in forms of credit and incentives to stimulate farm production. This agrees with the findings of Simon *et al.* (2015) who found that most cowpea farmers in Adamawa state do have access to formal credit but generate their sources of finance personally while others from friends and relatives.

Sources of Credit

The sources of farm credit by the respondents shows that out of the 39.6% of the respondents that have access to credit. 9.7% acquired credit from commercial bank, 9.7% from agricultural Bank, 14.6% from friends, while 7.6% from family members. This shows that the informal source provides major source of credit to the respondents as pointed out by Simon *et al.* (2015).

Annual Farm Income

Annual farm income of the respondents in Table 3 indicated that 11.1% earn less than N50,000 from cowpea production, 47.9% earned N50,000-99,000, 31.30% earned N100, 000-199,000, while 9.7% earned about N200,000 and more. The mean farm income was N101,277.78 with standard deviation of N51,021.254. This shows that the farmers are operating at a small-scale level and collaborate the findings of Joshua, T., Zalkuwi J and Audu, M. M. (2018). who found that most cowpea farmers in Mubi Local Government Area Adamawa state earn little income from cowpea production due to small scale and scattered farm units.

Access to Extension

The result of access to agricultural extension services by the respondents revealed that 6.3% have access to extension workers while 93.7%

do not. This shows that most farmers in the study area do not have access to agricultural extension workers and could imply that the farmers have to look elsewhere for assistance on matters relating to improved farming technology. Tijjani *et al.* (2015) reported that most farmers do not have access to extension agents but adopt new practices on their own or with the help of fellow farmers which may be due to inadequacy or insufficient number for extension workers to reach the farmers.

Membership of Association

The membership of association by the respondents shows that only about 16% were members of association while 84% were not. This shows that most of them do not belong to association and could be one of the weak linkages in social capital network for mobilization of farmers to benefits from numerous initiatives by government and private organizations to bettering the socio-economic status. This agrees with the findings of Zalkuwi *et al.* (2014) who reported low affiliation of farmers in association in Guyuk Local Government Area, Adamawa state, Nigeria.

Name of Association

The types of association by respondents revealed that all (16%) of the respondents who indicated interest in membership were members of Rice Farmers Association of Nigeria (RIFAN) which is an association supported by the current administration to boost rice production in the country**.**

Level of Utilization of Recommended Argo-chemical Practices by cowpea farmers

The level of utilization of recommended ago-chemical practices in Table 4 only few (24.3%) of respondents read of labels on the package/container, 33.3% Seeks help from others, if cannot read, 34% followed the instructions on the labels, 18.1% were

conscious of ago-chemical toxicity, 9% understood the level of toxicity, reading the labels on the label, while 33.3% neither eat nor drink, or smoke while spraying or applying ago-chemicals. Furthermore, the results indicated that only about 24.3% wash their hands with soap right after spraying or applying ago-chemicals, 37.5% keeps bottles/packages of ago-chemicals along with food items, 29.2% wash the sprayer in the pond/canal/river, 23.6% determine wind direction, 34% faces wind direction when spraying, 23.6% applied recommended dosage, while 19.4% applied two or more pesticides type together. This shows that most of the respondents do not use safety and recommended measure on ago-chemicals by cowpea farmers in the study area. This finding collaborates that of Franklin, N. M., Kwadwo, T. and Gideon D.,(2017) who reported that most of the farmers in Ghana do not stick to ago-chemicals safety usage specifically reading of labels use of personal protective clothes and washing of spray before and after usage. Similarly, Okoffo, E.D. Mensah, M. and Fosu-Mensah, B.Y. (2016) reported that farmers eat and drink during spraying and majority do not wear protective uniforms while many do not dispose of the containers but use them at home.

Table 4: Distribution of Respondents Based on Utilization of Recommended Argo-chemicals

Recommended Practices	Used	Not Used
Reading of labels on the package/container	35(24.30)	109(75.70)
Seeking help from others, if cannot read	48(33.30)	96(66.70)
Following the instructions on the labels	49(34.00)	95(66.00)
Awareness of ago-chemical toxicity	26(18.10)	118(81.90)
Understanding of the level of toxicity, reading the labels on the label	13(9.00)	131(91.00)
Eating, drinking, or smoking while spraying or applying ago - chemicals	48(33.30)	96(66.70)
Washing of hands with soap right after spraying or applying ago - chemicals	35(24.30)	109(75.70)
Keeping of bottles/packages of ago-chemicals along with food items	54(37.50)	90(62.50)
Washing of the sprayer in the pond/canal/river	42(29.20)	102(70.80)
Determination of wind direction	34(23.60)	110(76.40)
Facing of the wind direction when spraying	49(34.00)	95(66.00)
Application of recommended dosage	34(23.60)	110(76.40)
Application of two or more pesticides type together	28(19.40)	116(80.60)
Can overdose of ago-chemicals affect the crop stand	54(37.50)	90(62.50)
Use of ago-chemicals to store foodstuffs for consumption or animals feeding	26(18.10)	118(81.90)
Use of personal protective gears during ago -chemical spraying or application	40(27.80)	104(72.20)

Input dealers/ suppliers	34(23.60)	61(42.40)	0(0)	49(34.00)	368	2.60	6th

Influence of Socio-economic Characteristics on Utilization of Recommended Practices on Use of Agro-chemicals

The factors influencing the use of recommended practices on agro-chemicals by the respondents are presented in Table 5. The diagnostic test results in Table 6 revealed that the Ramsey RESET test and Breusch-Pagan / Cook-Weisberg test for heteroscedasticity were not statistically significant from zero, also the Variance Inflation Factor (VIF) with respect to all independents variable were less than ten. The model therefore is not spurious and is ideal for the analysis and interpretation of the results of data analysis.

Similarly, Table 7, the coefficient of multiple determinations R^2 revealed that 81.18% of the variations in utilization of recommended agro-chemical practices were explained by the variable included in the models. Age, household size, education, farm size, farm income, agro-chemical usage and number of extension visits were significant.

Age
Age (X_1) of respondents is negatively related to percentage utilization of recommended agro-chemicals and significant at 10%. This shows that as farmers age increases, there is every likelihood that their percentage utilization of safety agro-chemicals might decreases. The value of the coefficient indicated that if all other factors were held constant, 1% increase in the age of the farmers will decreases the percentage utilization of agro-chemical safety measures by 0.0139%. This agrees with the finding of Haddabi (2019) who found indirect relationship between age and use of insecticides to cowpea pests in Fufure Area of Adamawa state.

Household Size
Household size (X_3) has direct relationship with the percentage utilization of recommended agro-chemicals among respondents and significant at 1%. This could be expected because large household size enables individuals contribute their knowledge and wisdom and bring out the best that will be beneficial to all. The coefficient revealed that 1% increase in household size will lead to increase in the percentage utilization of safety recommended agro-chemical practices by 0.1395%. This also collaborate the finding of Haddabi (2019).

Education
Years of formal education (X_4) by respondents is positively related to utilization of safety recommended agro-chemicals by respondents and significant at 1%. This could be expected because if the literacy level of the farmers' increases, they will be able to read and understand important labels and safety precaution on the use of agro-chemicals. Holding all other variables constant, there will be 0.0296% increase in the percentage utilization of recommended practices for every 1% increase in level of literacy of the farmers. This agreed with the findings of Ekwempu and Anderson (2019) who indicated positive and significant relationship between literacy level and engagement in safe agro-chemical handlings among farmers in Plateau state.

Farm Size
The variable farm size (X_5) is positively related to the percentage utilization of safety recommended agro-chemicals practices and is significant at 10%. This shows that for every 1% increase in the farm size of respondents, there

will be 0.3043% increase in the percentage utilization of safety recommended agro-chemical measures by respondents. This shows that as farmers increases their scale of production by cultivating larger farm size. It will simultaneously lead to consciousness of the used of safety agro-chemical measures. This agrees with the findings of Jamala, G.Y., Ari, B. M., Tsunda, B. M. and Waindu, C.(2013).

Farm Income

Annual farm income (X_8) of respondents is positively and significant correlated with the percentage utilization of safety recommended agro-chemicals measure. The value of the coefficient 3.02e-06 revealed that when all other variables are kept constant, 1% increase in annual farm income will result in 3.02e-06% increase in the percentage utilization of safety recommended agro-chemical measures. Jamala *et al.* (2013) also found a positive and significant relationship between agro-chemical utilization and income of farmers in Guyuk Local Government Area of Adamawa state, Nigeria.

Agro-chemical Usage (liters)

The quantity of agro-chemical use (X_9) by respondents was significant and positively correlated with percentage utilization of safety recommended measures. The coefficient indicated that if agro-chemical usage by respondents increases by 1%, it will result to 0.6218% utilization in the safety recommended measures. This could be expected because when farmers use more of agro-chemicals on their farms; it will arise for the need to adopt safety

measures due to constant interaction with harmful chemicals. This result collaborate that of Matanmi B.M; Oladipo F.O; Adefalu L.L; Olabanji, O.P; Yusuf S.Y and Abdulkareem, T.Z, (2015). in a study they conducted on safety use of agro-chemicals in Oyo, Nigeria.

Number of Extension Visits

The number of extension visit to farmers was significant and positively related to the use of safety recommended agro-chemical measures among respondents. This could be expected because extension agents provide training to farmers on adoption and utilization of agricultural technologies. The value of the coefficient indicated that if all other variables were kept constant, 1% increase in the number of extension-farmers visit will ultimately lead to 0.8592% increase in the percentage utilization in the utilization of safety recommended measures by the respondents.

Table 5: Diagnostic Test Result

Type of Test	Value	Probability levels
Ramsey RESET test	1.70	Prob> F =0.1703
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	1.76	Prob> chi2 = 0.1848
Variance Inflation Factors (VIF) X_9	1.82	
X_8	1.78	
X_3	1.67	
X_{10}	1.37	
X_5	1.33	
X_4	1.28	
X_1	1.22	
X_2	1.09	
X_6	1.06	
X_7	1.05	
Mean VIF	1.37	

Table 6: Influence of Socio-economics characteristics on utilization of recommended use of agro-chemicals

Variables	Coefficient	Std. error	t-ratios
Age (X_1)	-0.0139	0.0074	-1.88*
Sex (X_2)	-0.2109	0.2429	-0.87NS
Household size (X_3)	0.1395	0.0288	4.84***
Education (X_4)	0.0296	0.0163	1.82*
Farm size (X_5)	0.3043	0.1707	1.78*
Farming Experience(X_6)	0.0221	0.0138	1.60NS
Access to Credit (X_7)	-0.0171	0.3785	-0.05NS
Farm income (X_8)	3.02e-06	8.37e-07	3.61***
Agro-chemical used (X_9)	0.6218	0.0898	6.92***
Number of Extension Visit (X_{10})	0.8592	0.1124	7.64***
Constant	22.6832	0.5826	38.93***

NB: *, ***=significant at 10% and 1% probability levels
R^2=0.8118, R^2 Adjusted=0.6590
F=57.38, Prob>F=0.000,
Root MSE=0.94175,
Number of observations=144

Conclusion

Based on the findings of the research, the study concluded that female farmers with reasonable level of formal education dominates cowpea production in the area. Most of the farmers were aware of the safety recommended practices on the use of agro-chemicals. However, only few of them were actually utilizing these safety measures during cowpea production. Factors such as Age, household size, education, farm size, farm income, agro-chemical usage (liters) and number of extension visits were significantly influencing the utilization of recommended practices on utilization of agro-chemicals.

Recommendations

I.   The study recommended that field training and practical educational programmes on good and safety use of agro-chemicals should be adopted by extension organization, government and private agencies to raise farmers' awareness level on the risk's association with inappropriate use of agro-chemicals.

ii.   Mass media facilities like radio and television were important source of information to the farmers. Intervention to increase farmers' awareness on health implications on agro-chemicals use in the study area should consider radio and television programmes in local languages to sensitize the farmers.

iii. Farmers should be given assistance in forms of loan and credit from financial institutions to enable them increase farm production which in turns stimulate the use of more recommended practices on agro-chemical utilization.

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