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Adoption of Recommended Agrochemical Practices among Cowpea Farmers in Kontagora and Mashegu Local Government Areas of Niger State, Nigeria

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ABSTRACT
The study was carried out to assess adoption of recommended agrochemical safety practices among cowpea farmers in Kontagora and Mashegu Local Government Areas of Niger State, Nigeria. One hundred and forty (140) cowpea framers were randomly selected for interview. Data collected were analyzed using descriptive statistics and Ordinary Least Square (OLS) regression. The results revealed that majority (77.2%) of the farmers were married and had just primary school education (43.6%). About half (47.9%) of the farmers were within 36-45 years of age with mean age of 36 years. Also, 63.6% of the farmers had household size of between 6-10 people with a mean of 7 people. More so, half (50.7%) of the farmers had farming experience of 6-10 age years. Majority (75.0%) of the farmers had farm size of 2.5–3.5 hectares, while 41.5% had access to extension contact. OLS results revealed household size had negative and significant influence on adoption rate of recommended agrochemical safety practices ($p<0.01$), level of education, farm size, cooperative membership, level of income and access to credit had positive and significant influence on adoption rate of recommended agrochemical safety practices ($p<0.05$) while extension contact had positive and significant influence ($p<0.10$). The results further showed farmers in the study area were aware of most of the recommended agrochemical safety practices. In addition, more than half (51.7%) of the farmers had moderately adopted the recommended agrochemical safely practices. Constraints identified include high cost of protective gadgets ($\bar{x} = 2.62$) and low literacy level among farmers ($\bar{x} = 2.50$). It was therefore recommended that farmers should be provided with protective gadgets by relevant stakeholders like NGOs at subsidized rate. More so, extension agents should sensitize and encourage the farmer to attend adult education classes in order to improve their literacy level.

Keywords: *Adoption, Agrochemical, Safety practices, farmers, cowpea.*

INTRODUCTION

Nigeria population increase on a yearly basis created needs more food. Crop farmers who are meant to meet this have suffered a serious setback as a result of pests, diseases, weeds and other inhibitors of crop growth. However different type of chemicals known as agrochemical have been produce to fight crop pests, plant diseases and control the effect of inhibitors through science and technology in crop production. Agrochemical is a generic term for the various chemical productions such as fertilizer, insecticide, hormones, fungicide and herbicides. The introduction of these chemicals is therefore an important farm innovation which when used by farmers can significantly improve crop production (Issa *et al.,* 2016).

Modern agriculture depends heavily on the use of chemicals for increased output. It has been estimated that 150 million tonnes of fertilizer and 6 million tonnes of pesticide are routinely applied to the field and crops annually,

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with the main objective of enhancing agricultural production (Bernhadt *et al.,* 2017). By and large, the ecological risk of these input to the environment are often ignored by the people, when not dismissed by those who assert that a growing human population needs to be fed at all cost (Popp *et al.,* 2013; Jeschke, 2016). However, Nigeria is adjudged to be the largest producer and consumer of cowpea in the world, with an estimated annual production of 2.7 million tonnes (Food and Agriculture Organization (FAO), 2014).

The notable States into cowpea production in Northern Nigeria include Katsina, Kano, Jigawa, Sokoto and Borno. The Northern region of the nation produces 1.7 million tonnes from about 4 million hectares, which represent over 60 percent of total national production (FAO, 2014). However, there has been a noticeable decline in cowpea yield in the Northern region due to problem of outdated farming practices, parasitic weed, insects and diseases (FAO, 2014). Cowpea is produced mostly by small-scale farmers using crude implements. The use of improved technologies can bring about cowpea yield of 1,500-2000kg/ha through mono cropping system, but only cowpea yield of 200-250kg/ha is obtained by small-scale farmers in the country (Wakil, 2013).

There is wide spread recognition that farmers misuse agrochemical while protecting crops from incidences of pests, disease and weeds. High incidence of agrochemical misuses and unprecedented level of pesticides related accidents and their attendant consequences on the people health is quiet disturbing (Fadlullah *et al.,* 2015). Available experience from different practioners reveals a demand-supply system that emerged by chance and therefore not perfect but characterized by adulteration, use of expired chemicals as well as improper use, improper storage habits, high retailing price and lack of safety measures (Fadlullah *et al.,* 2015).

Improper pesticide use had caused many people fell sick and even sometimes resulted in death (Olufemi, 2017). The effects of acute poisoning due to exposure to dangerous pesticide in food are apparently more severe in developing countries than in developed nations. It was reported that in Nigeria, 122 people were poisoned by pesticides contaminated food and as a result of this, two children lost their lives. Another recorded case of poisoning is 120 students who had consumed beans contaminated with agrochemical in Nigeria (Organic Consumer Associate (OCA), 2008; Integrated Regional Information Network (IRIN), 2008). Another scenario occurred, where three contract sprayers lost their live when they sprayed insecticide to control cowpea insect pest without wearing suitable protective gadgets. Also, two families lost key member when they slept in the same room where cowpea treated with fumigants was stored, due to inhalation (Dugji *et al.,* 2009).

Adoption of a few simple measures such as use of good quality sprayer, not smoking, eating and drinking during spraying, wearing headgears and changing clothes immediately after spraying may reduce the level of agrochemical poisoning among the farmers. This study was therefore carried out to access the level of adoption of recommended agrochemical safety practices among cowpea farmers in Kontagora and Mashegu Local Government Area of Niger State, Nigeria. The specific objective of the study are to describe socio-economic characteristic of cowpea farmers in the study area; examine their level of awareness of recommended agrochemical safety practice; assess the level of adoption of recommended agrochemical safety practice; determine the factors influencing the adoption rate of recommended agrochemical practices and examine constraints experience by the farmers in adopting recommend agrochemical safety practice.

METHODOLOGY

The study was carried out in Kontogora and Mashegu Local Government Area of Niger state, Nigeria. The State has between Latitudes 8° 20' and 11º 30' North and Longitude 3° 30' and 7º 40' East. Niger state covers an estimated land area of 76,481 square kilometer and the human population as at 2006 census stood at 3,950,246 (NPC, 2006). The State is in the tropical climate region marked by two distinct seasons wet and dry. The wet season commence late April and cease October, while the remaining months of the year is the period of dry season characterized by Harmattan and hot weather. The annual rainfall ranges from 1000mm–1600mm, while mean annual minimum and maximum temperature was 23ºC – 33ºC, respectively (NSADP, 2012). The basic pattern of land ownership is communal with crop production the major occupation of the people.

Three stages sampling procedure was used to select respondents for the study. The first stage involved purposive selection of Kontogora and Mashegu Local Government Areas (LGAs) due to preponderance of cowpea farming activities. The second stage was random sampling of three (3) villages from each of the LGAs selected. The third stage involved proportionate selection of 140 cowpea farmers using Yammane (1967) sample size determination formula. Primary data were obtained for the study using structured questionnaire complemented with an interview schedule. Trained enumerators assisted the researcher during the data collection. The data obtained were analyzed using both the descriptive statistics (such as frequency counts, percentage and mean) and inferential statistics (such as Ordinary Least Square (OLS) regression). More so, 3–point Likert rating type scale of Highly Aware (3), Aware (2) and Not Aware (1) was used to categorize the respondents' level of awareness. The decision rule was

based on mean score obtained by adding the points together (3 + 2 + 1 = 6) and divide by the number of points which is three (3) to get 2.0. Thus, computed mean value of greater than 2.0 implies aware, while value of less than 2.0 implies not aware.

The Ordinary Least Square (OLS) regression was used to determine the factors that influences cowpea farmers' adoption rate of recommended agrochemical safety practices in the study area. The OLS regression is explicitly expressed as:

$Y = \beta_o + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + Ui$

Where:

Y = Adoption rate of recommend safety practice expressed in percentage
a = constant
$\beta_1 - \beta_{11}$ = estimated coefficients
$X_1 - X_{11}$ = independent variables of the study
Ui = error term
X_1 = Age (year)
X_2 = Sex (male=1, otherwise=0)
X_3 = Marital status (married=1, otherwise=0)
X_4 = Education (year spent schooling)
X_5 = Household size (no. of people)
X_6 = Farming experience (years)
X_7 = Farm size (ha)
X_8 = Income (Naira)
X_9 = Cooperative membership (member=1, otherwise=0)
X_{10} = Extension contact (no. of visit)
X_{11} = Access to credit (Naira)

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of respondents considered for this study includes age, marital status, sex, education, farming experience, farm size and household size. The result on the socio-economic characteristics as presented in Table 1 revealed that majority (82.2%) of the respondents were within age bracket of 26-45 years with a mean of 35 years. This implies that most of the farmers in the study area were in their active and productive age, hence, more dynamic to innovation adoption. Also, majority (77.1%) of the respondents were married which could enhance access to family labour for active participation in farming activities, while 63.6% of the respondents has household size between 6-10 people. By implication, most of the farmers in the study area have a relatively large family size which provide more labour for the farming households. This finding corroborates that of Jamala *et al.* (2013) who reported that large household provide labour required for the family.

In term of educational level, majority (78.6%) of the respondents had formal education (primary, secondary and tertiary), while 21.4% of the respondents had no formal education. This implies that majority of the farmers are literate, hence could read and write. Level of education can increase the ability of a farmer to access and interpret relevant information about agricultural innovation and adoption of safety practices. This finding is in line with that of Suleiman *et al.* (2015) who reported that education have significant and positive relationship with the farmers' level of awareness of innovation, diffusion and adoption. Most (69.3%) of the respondents had farming experience of between 6-15 years with a mean of 10.5 years. This implies that cowpea farmers in the study area had enough experience in cowpea production which is vital in adoption of recommended agrochemical safety practice.

As revealed in Table 1, majority (75.0%) of the respondents had farm size between 1.5-3.5 hectares with a mean of 2.8 hectares implying that the cowpea farmers in the study area were small-scale farmers. This result concurs with the findings of Jamala *et al.* (2013) who reported that majority of cowpea farmers in Nigeria are small holders' farmers. Also, more than half (58.5%) of the cowpea farmers had no access to extension service, while 41.5% of the farmers had access to extension service. This implies that extension service delivery in the study area is low and could negatively affect farmers' adoption of recommended agrochemical safety practices. This finding agrees with that of Tijjani *et al.* (2015) who found extension service delivery to be low in their study area.

Table 1: Distribution of respondents based on their socio-economic characteristics (n=140)

Variables	Frequency	percentage	Mean
Age (years)			
< 26	11	7.9	
26 – 35	48	34.3	
36 – 45	67	47.9	36
46 – 55	11	7.9	
> 55	3	2.0	
Marital Status			
Single	24	17.2	
Married	10.8	77.1	
Divorced	6	4.3	
Windowed	2	1.4	
Household size (number)			
< 6	23	16.4	
6 – 10	89	63.6	7
11 – 15	23	16.4	
> 15	5	3.6	
Level of Education			
Non-Formal	30	21.4	
Primary school	61	43.6	
Secondary School	44	31.4	
Tertiary	5	3.6	
Farming Experience (years)			
< 6	22	15.7	
6 – 10	71	50.7	
11 – 15	26	18.6	10.5
> 15	21	15.0	
Farm size (hectares)			
< 1.5	12	8.6	
1.5 – 2.5	65	46.4	2.8
2.6 – 3.5	40	28.6	
> 3.5	23	16.4	
Extension contacts			
No contact	82	58.5	
Contact	58	41.5	

Source Field Survey, 2019

Level of Farmers' Awareness of Recommended Agrochemical Safety Practices

Awareness is expected to play an essential role in farmers' innovation adoption decision. This is because a farmer cannot adopt recommended practice if they are not aware of. Result in Table 2 showed that the cowpea farmers in the study area had good awareness and understanding of the recommended agrochemical safety practices. The farmers were particularly aware of the following recommended practice; avoidance of smoking, drinking and eating when spraying ($\bar{x}$ =2.84), keeping of agrochemicals away from children ($\bar{x}$ = 2.76), wearing of protective clothing ($\bar{x}$ = 2.66), wearing of nose protective shield ($\bar{x}$ = 2.66), avoidance of leaving agrochemicals in equipment over night ($\bar{x}$ = 2.66), the use of appropriate agrochemical ($\bar{x}$ = 2.64), frequent maintenance and repairs of equipment ($\bar{x}$ = 2.61), keeping agrochemicals away from source of drinking water ($\bar{x}$ = 2.55), avoiding the use of expired/banned agrochemical ($\bar{x}$ = 2.49), check for seal and original label ($\bar{x}$ = 2.46), following of the label instructions ($\bar{x}$ = 2.46), avoidance of spraying against wind direction ($\bar{x}$ = 2.45), avoiding animals from entering farmland sprayed with agrochemicals ($\bar{x}$ = 2.36), use of right equipment ($\bar{x}$ = 2.31), avoidance of over spraying of agrochemical on farmland ($\bar{x}$ = 2.30) and use of properly calibrated sprayer ($\bar{x}$ = 2.07). This implies that the cowpea farmers in the area were aware of most of the recommended agrochemical safety practices which could be attributed to their long experience of using agrochemicals.

Table 2: Respondents' level of awareness of recommended agrochemical safety practices

Variables	HA	A	NA	WS	MS	Remark
Avoidance of smoking, drinking and eating while spraying	118	21	1	397	2.84	Aware
Keeping agrochemicals away from children	106	34	0	386	2.76	Aware
Wearing protective clothing	97	39	4	373	2.66	Aware
Wearing nose protective shield	96	40	4	372	2.66	Aware
Avoidance of leaving agrochemicals in equipment over-night	94	45	1	373	2.66	Aware
Use the appropriate agrochemical	90	49	1	369	2.64	Aware
Frequent maintenance and repairs of equipment	86	53	1	365	2.61	Aware
Keeping agrochemical away from source of drinking water	78	61	1	357	2.55	Aware
Avoid the use of expired banned agrochemical	73	63	4	349	2.49	Aware
Wearing gloves and boots	70	66	4	346	2.47	Aware
Check for seal and original labels	66	72	2	344	2.46	Aware
Follow label instruction	71	62	7	344	2.46	Aware
Avoid spraying against wind direct	68	67	5	343	2.45	Aware
Avoid animal from entering farmland with sprayed agrochemical	52	86	2	330	2.36	Aware
Use of right equipment	45	94	1	324	2.31	Aware
Avoidance of over spraying of agrochemicals on farm land	44	94	2	322	2.30	Aware
Use of properly calibrated sprayer	16	118	6	290	2.07	Aware
Avoidance of using agrochemical container for ablution drinking	26	83	31	275	1.96	Not Aware
Avoidance of entering farm 12 hours after spraying	6	84	50	236	1.69	Not Aware
Proper disposal of agrochemical containers	13	68	59	234	1.67	Not Aware

Source: Field Survey, 2019

Note: HA=Highly Aware (3), A=Aware (2), NA=Not Aware (1), WS=Weighted Sum, MS=Mean Score

Level of Adoption of Recommended Agrochemical Safety Practices

Table 3 revealed that 20.0% of the farmers were low adopters of the recommended agrochemical safety practices, while 51.5% of them moderately adopted the recommended agrochemical safety practices and 28.6% of them highly adopted the recommended practices in the study area. This result implies that, majority of the cowpea farmers in the study area adopted the recommended agrochemical safety practices at different levels. This could be due to their long experience in the use of agrochemicals in their farming operations. Hence, this enables them to become aware of the health implication inherent in the use of agrochemicals. These findings corroborate that of Fadlullah *et al.* (2015) who reported crop farmers in their study area have used agrochemicals for 15 years and above. Thus, it was a general indication that individual with more experience in the use of agrochemicals would likely adopt the recommended practice.

Table 3: Respondents' level of adoption of recommended agrochemical

Level	Frequency	Percentages (%)
Low (1 – 5)	28	20.0
Moderate (6 – 10)	72	51.4
High (> 10)	40	28.6

Source: Field Survey, 2019

Factors Influencing the Adoption of Recommended Agrochemical Safety Practices

Ordinary Least Square (OLS) regression was used to determine the factors that influence adoption of recommended agrochemical safety practices by cowpea farmers in the study area and the results are presented in Table 4. The results revealed the coefficient of determination (R^2) value of 0.5261 which implies that about 53% variation in the adoption of recommended agrochemical safety practices by cowpea farmers was explained by the independent variables included in the model. From the t-value of the regression, six out of eleven independent variables in the model were found to be significant at 1%, 5% and 10% levels of probability, respectively.

The household size has negative coefficient (-0.166) and significant ($P<0.05$). The negative coefficient with respect to household size implies that household size have indirect influence on the adoption of recommended agrochemical practices by cowpea farmers; as the household size of the respondent increases, the level of adoption

of recommended agrochemical practices will decrease while other variables are kept fixed. This result contradicts that of Sanni *et al.* (2014) who reported positive and significant relationship between household size and level of technology adoption by cowpea farmers in Kano State Nigeria.

Level of education has positive coefficient (0.084) and significant (P<0.05). The positive relationship with respect to level of education implies that the higher the literacy level of the respondent, the higher the level of adoption of recommended agrochemical safety practices by the farmers. This is because education is expected to assist the farmers to understand the usefulness of agrochemicals to their system and its attendant health implications.

Farm size is also another important factor that has positive coefficient (0.146) and significant (P<0.05). This implies that the larger the farm size of the cowpea farmer the higher their level of adoption of recommended agrochemical safety practices. Membership of cooperative has positive coefficient (0.922) and significant (P<0.05). This implies that, the more respondent belongs to a cooperative society the more they will adopt recommended agrochemical safety practices.

Table 4: OLS estimates of factors influencing adoption rate of recommended agrochemical safety practices by the respondents

Variable	Coefficient	Standard error	z-values
Age	0.045	0.040	1.13
Sex	0.317	0.479	0.66
Marital status	0.446	0.280	1.59
Household size	-0.166	0.082	-2.03**
Level of education	0.084	0.041	2.06**
Farming experience	0.092	0.059	-1.55
Farm size	0.146	0.070	2.07**
Cooperative membership	0.922	0.397	2.32**
Income	1.22e-06	5.55e-07	2.20**
Access to credit	1.945	0.372	5.23***
Extension contact	0.684	0.345	1.98*
Constant	14.588	1.371	10.64***
F(11, 123) = 12.92***			
R – Squared = 0.5261			
Adjusted R – squared = 0.4854			

Source: Field Survey, 2019

Note: *, ** and * implies significant at 1%, 5% and 10% levels of probability, respectively.**

Income has positive coefficient (1.22e-06) and significant (P<0.01). This implies that as the income of the respondents increase, the more they will adopt recommended agrochemical safety practices. This corroborates findings by Ibrahim *et al.* (2016) who reported that, higher income of farmers leads to increase level of adoption of cowpea production technologies.

Access to credit also has positive coefficient (1.945) and significant (P<0.01). This implies that, the more access respondents have to credit the more they will adopt recommended agrochemical safety practices. This substantiates finding by Beckman *et al.* (2006) who reported that small holder farmers having access to credit have higher probability of adopting improved technologies and vice-versa.

Extension contact has positive coefficient (0.0684) and significant (P<0.10). This implies that, the more contact the respondents have with extension, the more they will adopt recommended agrochemical safety practices. This finding contradicts that of Enwerem and Ohajianya (2013) who found non-significant relationship between technology adoption and extension visit.

Constraints Associated with Adoption of Recommended Agrochemical Safety Practices

Table 5 revealed that high cost of protective gadgets ($\bar{x}$ = 2.62), low level literacy ($\bar{x}$ = 2.50) unfavorable attitude towards change ($\bar{x}$ = 2.24) and attitude towards risk taking ($\bar{x}$ = 2.12) were the most severe constraints associated with adoption of recommended agro-chemical safety practices in the study area. This implies that the cowpea farmers are constrained with finance to acquire protective gadgets and have poor knowledge on agrochemical safety measures. This agrees with Fadullah *et al.* (2015) who reported that high retailing price suitable protective gadgets and inadequate knowledge of safety measures were the constraints associated with agro-chemical usage.

Table 5: Constraints associated with adoption of recommended agrochemical safety practices

Variables	VS	S	NS	WS	MS	Remark
High cost protective gadgets	88	51	1	367	2.62	Very Severe
Low level of literacy	72	66	2	350	2.50	Very Severe
Unfavorable attitude towards change	56	62	22	314	2.24	Very Severe
Attitude towards risk taking	53	51	36	297	2.12	Very Severe
Ignorance of harmful effect of agrochemicals	13	91	36	257	1.84	Not Severe
Ability to identify genuine source of agrochemicals	2	38	100	182	1.30	Not Severe

Source: Field Survey, 2019
Note: VS = Very severe, S = Severe, NS = Not Severe, WS = Weighted Sum, MS =Mean Score
Bench Mean Score of < 2.0 implies Not Severe (NS), while ≥ 2.0 implies Very Severe (VS)

CONCLUSION AND RECOMMENDATIONS

Based on the findings from the study, it can be concluded that the cowpea farmers in the study area were in their active and productive age. Most of them were aware of the recommended agrochemical safety practices and had adopted it at different level. Factors such as household size, education, farm size, cooperative membership, income, access to credit and extension contact significantly influenced the farmers' quest to adopt recommended practice. However, high cost of protective gadgets and low literacy level were the most serious constraints that hinders the farmers' effort to adopt the recommended agrochemical safety practices. The study therefore recommended that, government and relevant stakeholders should assist the farmers with credit facilities at subsidized rate or grant to enable them acquire necessary protective gadgets. Agricultural extension agents should sensitize and encourage the farmers to adopt all the recommended safety practices due to the health implication inherent in the use of agro-chemicals.

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