




Factors Affecting the Adoption of Agrochemical Safety Measures among Crop Farmers in Southern Agricultural Zone of Nasarawa State, Nigeria

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Abstract

The study identified the factors affecting the adoption of agrochemical safety measures among crop farmers in the Southern Agricultural Zone of Nasarawa State, Nigeria. The specific objectives of the study include; identifying the rate of awareness of agrochemical safety measures, to identify adoption level of agrochemical safety measures and to determine the effect of socio-economic characteristic on the adoption of agrochemical safety measures. A multistage sampling technique was employed to select 220 crop farmers for the study. A structured questionnaire was used to obtain data and data were analyzed using descriptive and inferential statistics. The Result of the study revealed that farmers in the area were aware of the following agrochemical safety measures: avoid eating and drinking when using agrochemicals/bathing after spraying (85%), washing spraying clothes separately from other clothes (74%), and danger of ingestion/inhalation of agrochemicals (70%) among others. Also, results on the adoption of agrochemical safety measures show that 50% of the respondents adopted on a high scale level, 38% adopted on a medium scale and 12% adopted on a low scale. Level of education, extension contact, farm size, and household size were the socio-economic characteristics that had an influence on the adoption of agrochemical safety measures in the area. It is therefore recommended that extension workers should intensify an enlightenment campaign on the danger of exposure to agrochemicals in order to achieve full adoption of agrochemical safety measures by crop farmers.

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Introduction

Agriculture remains the foundation of the Nigerian economy, despite the presence of oil in the country. It is the main source of livelihood for most Nigerians (Food and Agriculture Organization, FAO, 2020). The sector comprises the following sub-sectors: crop production, livestock, forestry, and fishery sector. The crop production sub-sector remains the largest driver of all the four sub-sectors as it accounts for ninety-one percent of the agricultural sector in the third quarter of 2019 with a quarter growth that stood at 44.12% (National Bureau of Statistics, NBS, 2019). The sector

contributed 29.25% to the overall real GDP during the third quarter of 2019 (National Bureau of Statistics, NBS, 2019).

Agrochemicals are any chemical used in agricultural production to improve productivity and control pests and diseases (Omari, 2014). Saina *et al.*, (2017) viewed agrochemicals as chemicals used in farm operations to improve the quality and quantity of crop that is produced. It comprises fertilizers, plant-protection chemicals or pesticides, and plant growth hormones used in agriculture. The use of inorganic fertilizers and pesticides in developing countries has increased substantially in the past four decades. The

government encourage farmers to use agrochemicals so as to achieve national food security and increase crop production for exportation (Fleisher, 2006).

Adoption is a mental process through which an individual passes from first hearing about an innovation to its final adoption (Rogers, 1995). Adoption is facilitated by an agricultural extension agent whom are saddled with the responsibilities of transferring innovative technologies and programs to farmers that will bring about change in behaviour. Their services include provision of timely information, linking farmers to sources of agricultural inputs and credit facilities, creating awareness, and training/offering of practical solutions in all aspects of agriculture which include safety agrochemical usage. (Anaeto *et al.*, 2012)

Crop farmers make wide use of agrochemicals (pesticides) at different stages of their farm operations without adherence to agrochemical safety measures which include the use of personal protective equipments, appropriate mixing and application of chemicals, the correct agrochemical to use, proper disposal of used agrochemical containers etc. This can bring about health hazards such as eye irritation, skin burn/irritation, dizziness, stomach upset, headache and other serious illnesses like cancer (Adekunle *et al.*, 2017). Assessing the factors affecting the adoption of agrochemical safety measures is therefore necessary to address the concerns arising from crop farmers exposure to agrochemicals health hazards.

Specific objectives

- i. identify the socioeconomic characteristics of the respondents
- ii. identify the rate of awareness of agrochemical safety measures
- iii. identify the respondents' adoption level of agrochemical safety measures
- iv. identify the effects of socioeconomic factors on the adoption level of agrochemical safety measures.

Hypothesis

H₀: The socio-economic characteristic of the respondents has no effect on the adoption level of agrochemical safety measures in the study area.

Methodology

The study was conducted in Nasarawa State, North Central Nigeria. The State is made up of 13 Local Government Areas (LGAs), namely: Akwanga, Awe, Doma, Karu, Keana, Kokona, Lafia, Nasarawa, Nasarawa Eggon, Obi, Toto and Wamba. Farming is the main occupation of the people of the State which provides food as well as income. The State is made up of three Agricultural Zones namely: Central Agricultural Zone, Western Agricultural zone, and Southern Agricultural zone. The Southern Agricultural zone which comprises of Awe, Doma, Keana, Lafia, and Obi Local Government Area was used for the study.

Nasarawa State lies between latitude 7°45'N and 9° 25'N of the equator and between longitude 7° E and 9°25'E of the Greenwich meridian. It is characterized by a long period of the rainy season (April-October). The average annual rainfall is about 1200-2000mm per annum and the annual temperature ranges from 25-27.5°C (Binbol and Marcus, 2010). Agriculture is the dominant occupation of the inhabitants of the zone. The major crops grown in the zone include yam, maize, rice, cowpea groundnut, melon, sesame, millet, soya beans, and cassava among others. Tree crops are also found in the zone. The major ethnic groups in the zone are Alago, Kanuri (Kambari), Eggon, Migili, Gwandara (Agidi *et al.*, 2017).

The target population of this study comprises all crop farmers that use agrochemicals in the study area. A multistagesampling procedure was used in drawing the sample size from the population. The firststage involved random selection of three (3) LGAs out of five

LGAs in the zone. In the second stage, a random selection of three (3) villages from each of the three (3) selected LGAs was done, making a total of nine (9) villages;

and finally, 20% of the sampling frame (population) was selected randomly, to give 220 respondents as sample size.

Table1. Sampling frame of the study

Southern zone	Selected LGAs	Selected villages	Registered farmers	No. of Respondents (20%)
	Doma	Doma	200	40
		Rukubi	100	20
		Burumburum	80	16
	Obi	Obi	180	36
		Tudun-adabu	95	19
		kadunan koro	115	23
	Lafia	Maraban-akunza	110	22
		Akurba	120	24
		Adogi	100	20
Total	3	9	1100	220

The reliability of the instrument was determined using the test and re-test method. The instrument was administered to five respondents drawn from two communities at intervals of two weeks. The coefficients of 0.72, 0.78, 0.64, 0.79, and 0.91 were obtained at the different locations with a mean coefficient of 0.78 showing that the instrument is highly reliable.

Primary data were collected with the aid of a structured questionnaire and data were analyzed using descriptive statistics (frequency, percentages, ranking, mean and five-point Likert scale) and linear regression. The formulated hypothesis was tested using F-statistics.

The Linear Regression formula is shown below:

$$Y = \lambda_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_9 X_9 + \mu$$

Where,

Y = Level of adoption of agrochemicals safety measures. This is calculated as number of practices adopted by the individual respondent over the total practices identified in the literature expressed in percentage.

That is $Y = \frac{n_i}{N_t} * 100$

n_i = Number of practices by individual respondents

N_t = Total number of practices

$X_1 - X_9$ = Independent variables

X_1 = Age (years)

X_2 = Gender (2 = male, 1 = female, 0 = otherwise)

X_3 = Marital status (4 = married, 3 = single, 2 = divorced, 1 = widow)

X_4 = Education (No. of years)

X_5 = Household size (number)

X_6 = Farming experience (years)

X_7 = Farm size (hectare)

X_8 = Income (naira)

X_9 = Extension contact (No. of visits per year)

λ_0 = Regression intercept parameter

$\beta_1 - \beta_9$ = Regression coefficients

μ = Error term.

Results and Discussion

Socio-economic characteristics

The results of the socio-economic characteristics of the respondents are presented in table 2 and discussed as follows:

Age distribution: table 2 shows that 47% of the respondents were between 33-47 years old, 28% were between 18-32 years and 25% were above 47 years. the mean age was 40 years. This implies that the majority of the crop farmers were still in their productive age which means they are energetic and can actively engage in

carrying out safe agrochemical practices such as spraying. The result agreed with Afshari *et al.* (2019) who reported that the respondents were in their youthful age and actively involved in agrochemical safety practices.

Sex: The gender analysis revealed that most (75%) of the farmers were male and 25% were female. This implies that men were more into farming in the study area than women and hence, they tend to use agrochemical more than female crop farmers because of their higher purchasing power. This finding is similar to that of Tanko *et al.* (2018) who revealed that majority (76.92%) of the respondent were male, implying that men are dominant in farming operations, which could be due to many responsibilities that are hung on their shoulder as head of the family. It also agreed with Nyatuame and Ampiaaw (2015); Afshari *et al.* (2019); Jamala *et al.* (2013), and Eifediyi *et al.* (2014) who revealed that the majority of farmers that were involved in agrochemical practices were male.

Marital status: The majority (71%) of the crop farmers were married while only 29% were single. This means that the married individuals in the area are more into crop farming as they are more concerned with funding for food for their family than the singles whom may involved in other jobs for their personal well being. This is in agreement with Afshari *et al.* (2019), who observed that majority of the respondents were married.

Level of education: The finding revealed 31% of the farmers had secondary education, 25% had tertiary education, 19% had primary education while non-formal education had 25%. This implies that 75% of the respondents had one form of education or the other. The level of education was evident in their level of awareness of the agrochemical safety measures, as education enhances their understanding of the subject matter. Education plays a vital role in adoption of safety agrochemical practices thereby,

improving their ability in avoiding the risk accompanied with the use of agrochemicals. Tanko *et al.* (2018) reported a similar findings in their study .

Household size: The result shows that many (69%) of the respondents had a household size of between 1-10 persons, 25% had between 11-20 persons and only 6% had above 20 persons as their households size. The average household size of the respondents was 8 persons. This shows that farmers in the area had large household sizes. Large family size implies the availability of free family labour. This is also in agreement with Tanko *et al.* (2018) who observed that majority of the respondents had a household size of 1-10 person(s).

Farm size: Many (60%) of the farmers had 1-5 hectares of land, 19% had less than a hectare, 18% had 6-10 hectares while 3% had more than 10 hectares. The mean farm size was 4 hectares. The result is contrary to Jamala *et al.* (2013) who reported that the majority of the respondents in Guyuk, Adamawa State, had farm sizes of less than 1 ha. The larger the farm size, the more likelihood of using agrochemicals in farm operations.

Farming experience: The result shows that many (44%) of the respondents had the farming experience of between 11-20 years, 37% had the experience of 1-10 years while 19% had experience of more than 20 years, with the mean of 16 years into farming. This shows that the majority of the farmers were into crop production for many years and as such are very much experienced in farming. The long-year experience is expected to increase the ability and courage of the farmer to adopt measures that would guarantee their safety and as well increase their output/income level. The findings are in agreement with Afshari *et al.* (2019) who stated that majority of the respondents had a farming experience of 11-20 years. Similarly, Ekwempu and Anderson (2019) revealed that some (32.7%) of the

respondents had 11-20 years of experience with the use of agrochemicals.

Annual Income: The result on the income level of the farmers shows that most (69%) of the farmers earned within the range of ₦ 0.1million- ₦1million, 16% earn between ₦1.01 million-₦2million, 11% earned < ₦ 0.1 million, while 4% earned above ₦2 million. The mean annual income of the respondents was ₦673,418.

Extension contact: The finding on extension contact revealed that 32% of the sampled farmers had contact with extension officers 1-5 times annually, 15% had contact 6-10 times yearly and 25% had contact more than 10 times. While, 28% of the farmers had no contact with extension officers in a year. Extension contact as a major source of disseminating new agricultural technologies to farmers in the area is encouraging considering the fact that extension delivery system in Nigeria is below the required expectations with many farmers reporting that they rarely received one visit per annum from extension workers

(USAID, 2018). The result is contrary to Ogunjimi and Farinde (2012) who reported that 65% of the farmers in Osun State had no any visit of extension agents, whom are supposed to enlightened them on the need to adopt precautionary measures of using agrochemicals while 96.6% in Edo State, were not visited by extension agents.

Membership of cooperative: The results show that the majority (65%) of the crop farmers were non-members of the cooperative. This implies that the majority of the respondents do not belong to any cooperative society which could probably be attributed to absence/inadequacy of farmers’ cooperative association in the area. Being a member of cooperative societies could give farmers some privileges to access loan and farm inputs like agrochemicals easily from the government and other donor agencies, it could also help farmers in interacting with one another to share basic knowledge like the safe use of agrochemicals.

Table 2. Distribution of the respondent according to their socio-economic attributes

Factor	Frequency	Percentage	Mean
Age			
18-32	61	28	40
33-47	103	47	
Above 47	56	25	
Gender			
Male	164	75	
Female	56	25	
Marital Status			
Married	156	71	
Single	64	29	
Educational Level (Years)			
None	56	25	
Primary	41	19	
Secondary	69	31	
Tertiary	54	25	
Household Size (Number)			
1-10	151	69	8
11-20	56	25	
Above 20	13	6	
Farm Size (ha)			

<1	42	19	4
1-5	133	60	
6-10	39	18	
> 10	6	3	
Farming experience (Years)			
1-10	82	37	16
11-20	97	44	
Above 20	41	19	
Income (Naira)			
< 0.1m	25	11	₦673,418
0.1m-1m	152	69	
1.01m-2m	35	16	
> 2m	8	4	
Extension contact (Number)			
No contact	61	28	
1-5	71	32	
6-10	33	15	
Above 10	55	25	
Membership of Cooperative			
Non-Member	142	65	
Members	78	35	

Source: Field survey (2021)

Rate of awareness of agrochemical safety measures

The results in table 3 show the rate of awareness of agrochemical safety measures by the respondents. The findings imply that respondents' awareness rate of agrochemical safety measures was high. The results revealed that the majority 85% knew about not eating/drinking when applying agrochemicals as well as taken their bath after spraying; 74% knew about washing their spraying clothes separately from other clothes. The result agrees with the research of Tanko *et al.*, (2018) in Bali LGA of Taraba State, who reported high level of awareness in safe use of agrochemicals, revealing that 86.54% of the farmers knew about covering food/water when spraying, 83.33% avoid drinking, eating and smoking during spraying, 77.57% were aware of avoiding ingesting/inhaling of agrochemical during spraying, 76.92% avoid skin contact with agrochemicals among others.

Table 3 also shows that 70% of the respondents were aware of the implication

of ingestion/inhalation of agrochemicals. On appropriate dilution and storage of agrochemical, not less than 69% of the respondents were aware. Furthermore, 68% are knowledgeable of the appropriate agrochemical to use; this could be due to their level of educational attainment or exposure to different agrochemicals by agrochemical dealers or agents from Agrochemical Company. The study further revealed that 62% of the respondents were aware of the need to buy agrochemicals from reputable sources, 57% was aware of no spraying during windy period. Change in wind direction could cause droplet deposits of chemical on the body of the operator, a situation that can pose health hazard. Finally, 55% of the respondents were aware of the need to avoid skin contact with chemicals.

However, the result also shows that the use of personal protective equipment had (44%) and puncturing/burning of agrochemical container (31%) had low awareness rate by the respondents. Poor awareness of the safety measures

particularly the use of PPE could endanger the health of respondents while using agrochemical on the farms.

Table 3. Distributions of respondents based on awareness of agrochemical safety measures

Variables	Frequency	Percentage
Avoid eating/drinking when spraying	186	85
Directly bathing with soap and water after spraying	186	85
Washing of spraying cloth separately from other cloths	163	74
Avoid ingestion/inhalation of chemical when spraying	155	70
Appropriate mixing/dilution of agrochemical	152	69
Proper storage of agrochemical	152	69
Use of correct/appropriate chemical	149	68
Buying of chemicals from reputable source	137	62
Avoid spraying during windy period	125	57
Avoid skin contact with chemicals	122	55
Use of PPEs	96	44
Reading of instruction on label before use.	89	40
Puncturing/burning of agrochemical container after usage	69	31

Source: Field Survey (2021)

Multiple Responses

Level of adoption of agrochemical safety measures

The results in table 4 show various categorizations of adoption levels of agrochemical safety measures using 5-point scale of adoption. The result shows that very high adopters constituted 32%, high adopters were 18% and medium adopters comprise 38%. While the low and very low adopters of agrochemical safety measures in the study areas were 7% and 5% respectively. Invariably, the result implies that high adopters, medium adopters and low adopters constituted 50%, 38% and

12% respectively. The result implies that agrochemicals safety measures is gaining ground in the study area. This could be due to their level of educational attainment or access to extension contact that brings about high rate of awareness on the need for agrochemical safety measures.

On a contrary, Umar *et al.* (2013) on their study in Niger State, Nigeria, revealed low adoption of safe agrochemicals usage by the respondents which they said could be due to inadequate information and knowledge of the respondents on dangers of agrochemicals.

Table 4. Distribution of respondents on their level of adoption in agrochemical safety measure practices

Range (%)	Frequency	Percentage	Level of adoption
1-20	7	5	Very low
21-40	10	7	Low
41-60	56	38	Medium
61-80	27	18	High
Above 80	48	32	Very high

Source: Field Survey (2021)

Multiple responses

Effects of Socio-economic characteristics of the respondents on their level of adoption of agrochemicals safety measures

The results in table 5 show the regression analysis which revealed that education (0.012), extension contact (0.012), farm size (0.014) and house hold size (0.010) were found to positively influence the adoption of agrochemical safety practices in the study area. This depicts that a unit increase in any of the four variables would enhance adoption of safety practices of agrochemical usage. Education and extension contact were highly significant at 1% level of significance, while farm size and household size were significant at 5%.

The education variable was positive and significant at 1%. This implies that the higher the level of education of the farmers, the higher their level of adoption of safety agrochemical measures. This agrees with Tanko *et al.* (2018) who reported education (0.0267) to be statistically significant at 1%, and the major factor that positively influenced the adoption of safe use of

agrochemicals by respondents in Bali LGA of Taraba State, Nigeria.

Also, the coefficient of extension contact was also found to be positive with 1% level of significance. This means that the more the visit of extension agents to farmers, the higher their adoption of agrochemical safety measures. Extension visits will go a long way in encouraging farmers on the need to adopt safety agrochemical measures and guide/train them on some safety practices.

Farm size was positive and significant at 5% level. This implies that the larger the size of a farmers' farm, the more their adoption of agrochemical safety practices. House hold size was also positive and found to be significant at 5%. This also means that the larger the number of house hold of the respondent, the more their adoption level of the safety agrochemical practices.

For the hypothesis of the study,

Since the F-statistics (7.370) is significant at 1% level of significance, we reject the null hypothesis and conclude that there was a significant relation between the socioeconomic characteristics of the respondents and their level of adoption

Table 5. Regression analysis of effect of socioeconomic characteristics on the level of adoption of agrochemical safety measures

Variable	Coefficient	Std. Error	t-Statistic	Prob
Constant	0.114	0.287	0.398	0.691
Age	-0.004	0.003	-1.311 ^{NS}	0.192
Education	0.012	0.003	3.641 ^{***}	0.000
Extension Contact	0.012	0.002	4.883 ^{***}	0.000
Farm experience	0.003	0.004	0.683 ^{NS}	0.410
Farm size	0.014	0.007	1.991 ^{**}	0.049
Household size	0.010	0.005	2.042 ^{**}	0.043
Income	0.029	0.023	1.284 ^{NS}	0.202
Gender	0.030	0.043	0.692 ^{NS}	0.490
Marital status	0.049	0.045	1.0798 ^{NS}	0.282
F-Statistic	7.369 ^{***}			0.000
R ² = 0.334				

Source: Authors estimated regression result (2021).

Note: *** = Significant at 1%, ** = Significant at 5%, and NS= Not significant

Conclusion

The majority of the respondents in the study area were aware of safety precautionary measures in agrochemical usage. The adoption of agrochemical safety measures in the area revealed that 50% of the respondents adopted on a high scale, 38% adopted on a medium scale and 12% adopted on a low scale. Educational attainment, extension contact, household size, and farm size were found to positively and significantly influence adoption of agrochemical safety measures in the area. Since there is significant relationship between socioeconomic characteristics of the crop farmers and adoption level of agrochemical safety measures. It is therefore recommended that Extension Agents should intensify enlightenment campaigns on the danger of exposure to agrochemicals and encourage crop farmers towards achieving full adoption of agrochemical safety measures in the study area.

Conflict of interest

Regarding the publication of this manuscript, the authors declare that there are no conflicts of interest.

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