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FACTORS AFFECTING AWARENESS OF MAIZE FARMER ON HEALTH RISK OF AGROCHEMICAL USAGE IN NIGER STATE, NIGERIA

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ABSTRACT
The study examined the factors affecting awareness of maize farmers on health risk of agrochemical usage in Niger State, Nigeria. A three stage sampling procedure was adopted in selecting the respondents. To achieve this research objective, a cross- sectional survey of maize farmers in six (6) Local Government areas (LGAs) was carried out on 181 respondents. Descriptive statistics and probit regression method were used to analyze the data. The results indicated that maize farming in the State was dominated by married men with mean age and farming experiences of 43 years and 13 years, respectively. Furthermore, most farmers do not read nor follow agrochemical instruction which might have led to some health challenges like difficulty in breathing, chest pain, and sneezing, and eye problem. The probit result shows that age, sources of information, labour reduces the odds of agrochemical health risk, while increase in farming experience, farm size, membership of association and cost of seed increases the odds of agrochemical health risk awareness. The study concluded that maize farming was dominated by married male farmers who are married and had a mean age of 43 years; also, difficulty in breathing, chest pain, eye problem and sneezing topped the health hazards factors as perceived by the farmers. It was therefore recommended that, awareness campaigns and mass trainings on the use, handling and application of agrochemicals should be encouraged in order to achieve effective and safe use of agrochemicals in the study.

Keywords: Agrochemical use; Health risk awareness; Maize farmer, Perception, Probit model.

INTRODUCTION
The need to increase agricultural productivity is seen as one of the major way to effectively tackle the current global food crisis. Food and Agriculture Organization (FAO, 2007) reported that Nigeria is blessed with a huge expanse of arable land, favorable climate, abundant streams, lakes, forests and grassland, as well as a large, active population that can sustain a highly productive agriculture with a great potential to become the food basket of the West Africa sub-region. Also, Aduba *et al. (*2013) has pointed out that Nigeria has about 79 million hectares of arable land, of which 32 million hectares are cultivated, both crop and livestock production remains below potentials although the average agricultural growth rate

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was 7% between 2006 and 2008, this growth lies below the 10% necessary for attaining food security and poverty reduction.

Maize (*Zea mays*) is one of the major staples in Nigeria after rice and wheat and is a cereal crop that is grown widely throughout the world in a range of agro -ecological environments. Maize was introduced into Africa in more than 150 decades ago and has since become one of the dominant food crops especially in developing countries of the world. It originated from South and Central America and was introduced to West Africa by the Portuguese in the 10th century (FAO, 2013). More so, maize is a hot season crop and is grown principally in areas with temperatures range of 21 - 30ºC 70 - 86 F), though seeds germinate best at a lower temperature range of 18 - 21ºC (Sowunmi and Akintola, 2010) in agricultural economy. It serves as both food for human beings, feed for animals and other industrial raw materials. Ironically, the demand for maize as a result of various domestic uses sometimes outstrips supply (Akande 2004, and Jibrin *et al.,* 2016).

Sadly, Nigerian agriculture has many features among which the magnitude of the farm size is most important. Over the past few decades, the farm size has decreased mainly due to inheritance and transfer, the growing increase in the number of farms might be due to combined effect of institutional, technological and demographic factors. The size distribution of farm holdings in Nigeria are categorized as: Small scale farms, ranges from 0.10 to 5.99 ha, medium scale, 6.0 to 9.99 ha and large scale above 10 ha. These classes constituted 84.49%, 11.28% and 4.23% respectively (Ado, 2016; Oksana, 2005; Oluwatayo, 2008; Opaluwa, 2014 and National Bureau of Statistics [NBS], 2006). Furthermore, other factors like insufficient capital, price fluctuation, disease and pest, poor storage facilities have been linked with low maize production in the country (Ojo, 2003). Also, Jibrin *et al.* (2016) reported that shortfall of storage facilities make most farmers sell their produce at low prices immediately after harvest in other to prevent spoilage there by leading to poor prices for agricultural produce. Other constraints according the author include inadequate extension services, poor transportation facilities, pilfering (theft), poor prices for agricultural products and inadequate rainfall.

Therefore, the production of the crop must be increased in order to ensure food and income security through the development of improved maize varieties and technology. As a result of its high demand, maize is gradually becoming more expensive for poor consumers, thus the need for its increased production can never be over emphasized, the use of agrochemical (Badmus and Ariyo, 2011).

Agrochemical (fertilizer, pesticides, herbicides, and nematicides) have played an important role in the success of modern food production in terms of increased food production, increased profits for farmers and the prevention of diseases and maize farmers have been found to use a wide range of pesticides at different levels to reduce losses from pests and diseases (Silvanus, 2014). Furthermore, agrochemical have posed a number of problems for agriculture, including the killing of beneficial insects, secondary pest outbreak, the development of pesticides resistance pests, health problems for farmers that handle the chemicals such as abdominal pain, dizziness, headache, nausea, vomiting as well as skin and eye problems (Ecobichon,1996 and Banjo, *et al* 2010). World Health Organization (WHO, 2000) estimated

that each year, 3 million farmers in the developing world experience sever poisoning from pesticides, about 18,000 of whom die. This means that the high probability of pesticides use and pesticides induced side effect growing in developing countries would be a reality if the farmers' rate of awareness, knowledge, attitudes and practices on pesticides use are not properly considered with necessary actions taken in accordance to the recommendations (Banjo *et al* 2010).

The general objective of the study was to determine the factors affecting maize farmer's awareness on agrochemical use in Niger State, The specific objectives were to:
(i) describe the socio-economic characteristics of maize farmers in the study area;
(ii) assess the awareness of farmers on the use of agrochemical; and
(iii) describe the perceived health hazards associated with agrochemical use.

MATERIALS AND METHODS

The Study Area

The study was conducted in Niger State, Nigeria. Niger State is located in the Guinea savannah ecological zone of Nigeria. In terms of land mass, it is the largest in Nigeria. It covers a total land area of 74,224km^2 accounting for about 8% of Nigeria's land area. About 85% of its land area is good for arable crop production (Niger State Geography Information System, 2015). It is located between Latitudes 8 ^{0} 11' N and 11^0 20' N and Longitude 4^0 30' E and 7^0 20' E (National Bureau of Statistics [NBS], 2015). It is bothered to the Northeast by Kaduna State and the Southeast by the Federal Capital territory, Abuja. The State covers an estimated land area of 76,363 square kilometers and a population of 4, 082, 558 people according to 2006 census (National Population Commission [NPC], 2006). However, the projected population as at 2017 using 3.4% growth rate is 7,141, 7331.

The State is has 25 Local Government Areas (LGAs) that are grouped into three (3) agricultural zones (I, II, and III) with the zones having eight (8), nine (9) and eight (8) LGAs, respectively. Nupe, Gwari, Hausa are the major ethnic groups in the State. The other minor ethnic groups are Koro, Kakanda, Kadara, Ganagana, Dibo, Kambari, Kamuku, Pangu, Dukawa, Angwai, Igbo, and Yoruba. The State experiences distinct dry and wet seasons in the southern parts. With annual rainfall varying from 1,100mm in the Northern part to 1,600mm in the southern parts and average annual rainfall is about 1,400. The State is blessed with abundant mineral resources such as gold, clay, silica, Kyanite, marbel, copper, iron, feldspare, lead, columbite, kaoline and tantalite (Niger State Ministry of Information, 2012). The State is agrarian and well suited for production of arable crops because of the favorable climatic conditions. The inhabitant of the State also rears some livestock like goat, sheep cattle and chicken among others (Niger State Ministry of Information, 2012).

Sampling Techniques and Sample Size

The respondents were selected using a multi-stage random sampling procedure. In the first stage, two (2) LGAs where randomly selected from each of the three agricultural zones in the State, i.e., Bida, Agaie, Chanchaga, Bosso, Kontagora and Mariga. Second stage involves random selection of two (2) communities/villages from each of the six (6) LGAs, i.e.,

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Bia, Dabarako, Nami, Gipo 1, Birigi, Sauka-kahuta, Maikunkele, Tagwai, Kampani wuya, Tungan kawo Mariga and Durgu. The third stage involve sampling of maize farmers proportionately using Yamane's formula (1967) as used by Jibrin, *et al.* (2019); so, a sample size of 181 was obtained:

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

where;
n = sample size,
N = finite population,
e = limit of tolerable error (level of significance = (0.07),
1 = constant. Applying the formula above, a sample size of 181 was obtained for Niger State.

Method of Data Collection

Data for this study was collected through primary sources. The primary data was obtained using questionnaire and complimented with interview schedules for the non-literate respondents.

Analytical Techniques

Data collected included information on socio economic characteristics (age, sex, marital status, and years of farming experience). Also, the input, output, farm size, labour, fertilizer, capital and perceived health hazards of agrochemical. The data collected were analyzed using descriptive statistics and Probit regression analysis. Implicit form of the regression model is specified as:

$Y = f(X_1, X_2, X_3, X_4 \ldots Xn, ei)$ … (2)

$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_{6\ldots} + ei$ … (3)

where;
Y = Awareness level (Aware = 1; Not = 0)
X_1 = Age (Years)
X_2 = Sex
X_3 = Farming Experience (Years)
X_4 = Education (Years)
X_5 = Herbicides/pesticides (₦)
X_6 = Farm size (Ha)
X_7 = Fertilizer (kg)
X_8 = Amount of credit (₦)
X_9 = Membership of association (Dummy)
X_{10} = Extension visit (Dummy)
X_{11} = Cost of seed (₦)
X_{12} = Sources of information (number)
X_{13} = Labour (Mandays)
X_{14} = Maize output (kg)
e = error term.

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RESULTS AND DISCUSSION

Data in Table 1 showed about 34% the farmers where within the age range of 41-50 while their mean age was 43 years which implies that the farmers are still young and are expected to be more active and productive on the farm and this active age is likely to make them more responsive to the adoption of innovations than the older counterpart. This is in disagreement with the findings of Jibrin *et al.* (2016) who reported that maize farmers were within the age of 31 – 40 years. 76.24% of the maize farmers sampled in Niger State where male while their female counter part accounted for 23.75%. This implies that maize farming in the state is dominated by male. The result is in consonance with the findings of Mohammed *et al.* (2013) and Oladejo and Adetunji (2012) who reported that maize farming in their various study area was male dominated.

Furthermore, about 88.95% of the respondents are married, 6.07% are single, 0.55% are divorced and 4.41% are widowed. Since the larger percentages of the respondents are married, it implies that the family sizes might increase and enhance provision of family labour. This agrees with the findings of Isah (2014) who opined that size of the family help to boost family labor as the author reported that 87 % of the farmers were married. The mean household size was 8 and is in disagreement with the findings of Franklin *et al.* (2017) who concluded that the mean household size of maize farmers was 6.

Table 1 also revealed that about 73.999% of the maize farmers have one form of education or the other, the literacy level is generally high and this might have positive influence in their ability to adopt improved farm practices for maize production, thus leading to high productivity. Mustapha *et al*. (2017) opined that educated farmers and younger farmers were significantly more likely to use PPE compared to older famers with little or no formal education. while higher levels of education gives agrochemical users greater chances to information and more knowledge of the hazards associated with agrochemical use and how to prevent direct contact, less educated farmers may be disadvantaged in their ability to understand the hazard and caution on agrochemical safety and health information, how to prevent direct contact and how to follow approved safety and application guidelines.

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Table 1: Socio-economic Characteristics of the Respondents

Variables	Frequency	Percentage	Mean (Std. dev.)
Age			
≤ 30	36	19.88	43 (10.58)
31 – 40	62	34.25	
41 – 50	63	34.80	
51- 60	16	8.83	
Above 60	4	2.20	
Sex			
Male	138	76.24	
Female	43	23.75	
Marital status			
Single	11	6.07	
Married	161	88.95	
Widow	8	4.41	
Divorce	1	0.55	
Household size			
1- 5	67	37.01	8 (5.5)
6 – 10	66	36.46	
11 – 15	27	14.36	
Above **15**	21	11.60	
Level of education			
None	47	25.96	
Quranic	12	6.62	
Primary	43	23.76	
Secondary	44	24.30	
Diploma	13	7.18	
NCE	12	6.62	
HND	5	2.76	
Nursing	2	1.10	
Degree	3	1.65	
Farm size			
0.1-1.0	64	35.35	2.54 (2.29)
1. 1- 2.0	54	29.83	
2.1- 3.0	31	17.12	
3.1 and above	32	17.67	
Years of farming experience			
1-5	45	24.86	13 (9.5)
6-10	54	29.83	
11-15	20	11.04	
16-20	32	17.67	
21 and above	30	16.57	
Extension contact			
0-5	178	98.34	2.0(1.10)
6-10	3	1.65	

Source: Field survey (2019)

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More so, from Table 1, 82.3% of the maize farmers in Niger State had farm size of less than 3 hectares. This implied that the farmers had small farm sizes which indicated the subsistence level of farming, mean years of farming experience of the sampled maize farmers was 13 while the mean for extension visit for the maize farmers was 2.0. The result is in line with the findings of Olaniyi and Adewale (2012) who reported that the average farm size of the farmers in the study area was 2 hectares while the mean farming experience was 12 years. The mean for extension visit for the maize farmers was 2.0. The result is in concordances with the findings of Ademiluyi, (2014) who found out the 72.97% of the respondents had no access to extension agents.

Awareness Statement of Maize Farmers on Agrochemical Handling

Table 2 presents data on awareness of maize farmers when handling agrochemical. Only 39.77% of the respondents read before opening agrochemical bottle agrochemical while about 88.95% of the maize farmers agree those agrochemicals are hazardous in nature.

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Table 2: Awareness Statement of Farmers on Agrochemical Handling

Awareness statement	*Frequency	Percentage
Do you read label before opening agrochemical bottle?	72	39.77
If you cannot read, do you seek for help from others?	126	69.61
Do you follow the instructions on the label?	29	16.02
Are you aware of agrochemical hazards	161	88.95
Are you able to understand the level of hazard by reading the label	106	58.56
Do you drink, eat or smoke while applying or mixing agrochemical	23	12.70
Do you keep bottles/packages of agrochemical along with other food items	49	27.07
Do you store agrochemical properly/ keep away from children?	150	82.87
Do you apply two or more pesticides 'type together?	84	46.40
Do you wash the sprayer/bottle in pond/canal/river/others?	124	68.50
Do you dispose unused container properly?	93	51.38
Do you spray when it is windy?	40	22.09
Do you determine the wind direction first before spraying?	158	87.29
Do you use agrochemical for the purpose they are meant for?	130	69.14
Do you apply recommended dosage to prevent environmental contamination and human health hazards?	97	53.59
Do you use personal protective gears such as gloves and overall clothing during agro-chemical mixing or spraying?	93	51.38
Dose overdose affect plants?	171	94.47
Do you wash your hands with soap right after applying or mixing agro-chemical?	139	76.79
Do you take your bath after spraying?	70	37.23
Do you revisit the farm within 24hours of spraying?	136	75.13
Do you avoid the use of agro-chemical when advise not to work with such component?	67	37.01
Do you keep unprotected persons out of treatment area for at least 12hours?	116	64.08
Do you ensure proper ventilation before re-entry?	95	52.48
Do you seek immediate attention in case of accident?	45	23.93

*Multiple responses exists
Source: Field survey (2019)

Table 2 also show that 16.02%, 12.07%, 51.38% and 87.29% of the respondents agrees that they follow the instructions on the label, drink, eat or smoke while applying or mixing agrochemical, dispose unused container properly and that they consider wind direction before applying agrochemical.

Also, 53.59% of the maize farmers tends to apply recommended dosage to prevent environmental contamination and human health hazards, 94.47%, agree that over dose affects plant growth, 37.23% take your bath after spraying, 37.01% avoid the use of agro-chemical when advise not to work with such component, while 52.48% ensure proper ventilation before re-entry into their farms in order to ensure that they do not inhale the chemical. The result is in

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line with the findings of Adesuyi *et al.* (2018) who reported that only 22.10% of the respondents read agrochemical label, 51.90% strongly agree that agrochemical affect human health, 41.60% always take their bath after using agrochemical while 33.80 talk when mixing or applying agrochemical.

Perceived Health Hazards of Maize Farmers on Agrochemical Use

The result on Table 3 shows that pain and difficulty in the breathing where the most sever health symptoms respondents faced as a result of not adhering to agrochemical safety knowledge. Also, eye problem, sneezing ranked 2nd and 3rd with mean weight of 2.32 and 2.27, respectively. Furthermore, skin irritation was also severing among the respondents. The occurrence of these health symptoms could probably be to the fact that most maize farmers do not use the recommended personal protective equipment when handling agrochemical. The result is in consistent with the findings of Adesuyi *et al.* (2018) who reported that headache, itchy eyes, fatigue, skin irritation, dizziness and coughing as some of the health symptoms respondent face in the study area. Lekei and Ngowi (2016) corroborated this results by reporting that unsafe handling of agrochemical tends to increase the risk of pesticide exposure, which might lead to serious health challenges.

Table 3: Perceived Health Hazards of Maize Farmers on Agrochemical Use

Perceived health hazards	*Very Sever (3)	*Sever (2)	*Not sever (1)	Sum weight	Mean weight	Overall Perception	Rank
Sneezing	59 (177)	113 (226)	9(9)	412	2.27	Sever	3rd
Chest pain	116 (348)	19 (38)	46(46)	420	2.38	Sever	1st
Eye problem	77 (231)	85 (170)	19(19)	420	2.32	Sever	2nd
Skin irritation	51 (153)	120 (240)	10(10)	403	2.22	Sever	4th
Cough	12 (36)	75 (150)	94(94)	280	1.54	Not sever	6th
Diarrhea	3 (9)	38 (76)	140(140)	225	1.24	Not sever	7th
Headache	11 (33)	103 (206)	67(67)	306	1.69	Not sever	5th
Breathing difficulty	81 (243)	89 (178)	11(11)	432	2.38	Sever	1st

Note: Figures in parentheses are percentages; *multiple responses exists.
Source: Field survey (2019)

Factors Affecting Maize Farmer's Awareness on Agrochemical Use

Since the parameter estimates of the probit regression model provide only the direction of the effect of the independent variables on the response variable; estimates do not represent the actual magnitude of change or probabilities. Thus, the marginal effects from the model which measure the expected change in the probability of awareness with respect to a unit change in an independent variable are presented in Table 4.

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Table 4: Estimates of Factors Affecting Maize Farmer's Awareness on Agrochemical Use

Variable	Co-efficients	Standard errors	Z-Value	P-value
Age (years)	-.0260101	.0130417	-1.99	0.046
Farming Experience (years)	.0548529	.0227885	2.41	0.016
Educational level (years)	-.0282816	.0427204	-0.66	0.508
Herbicides/pesticides(₦)	-7.11e-06	.0000132	-0.54	0.589
Farm size (Ha)	| .1817965	.0836056	2.17	0.030
Fertilizer (kg)	-.0005658	.0009016	-0.63	0.530
Amount of credit received (₦)	-8.69e-06	8.16e-06	-1.06	0.287
Membership of association ((dummy)	5128814	.3009394	1.70	0.088
Extension visit (dummy)	| -.0518692	.0437304	-1.19	0.236
Cost of seed (₦)	.0001091	.0000358	3.04	0.002
Sources of information (number)	-.1271688	.0653359	-1.95	0.052
Labour (Mandays)	-.0813571	.0307684	-2.64	0.008
Maize output (kg)	-.0000444	.0000776	-0.57	0.567
Constant	1.698873	.6324854	2.69	0.007
Log likelihood = -77.938845				
Prob > chi 2 = 0.0000				
Pseudo R2 = 0.3135				

Source: Field survey (2019)

Marginal Effects Obtained from Probit Regression Result

Table 5 shows that age of was found to be negatively signed and significant at 5% probability level. This implies as the age of the farmers increase by one year the odds of their awareness on the use of agrochemical tends to reduce by -1.99 (-.0260101), i.e., older farmers are more likely to become aware of agrochemical use than the younger ones. This could be attributed to the fact that older farmers probably might have gathered more information and knowledge about agrochemical use over the years. The result is in contrast with the findings of Tijjani *et al.* (2018) who reported that as the age of farmer increases, the probability that the farmer awareness on the use of agrochemical decreases. Farming experience and farm size were positively signed and significant at 5% each with agrochemical awareness indicating that a year increase in experience and increase in 1ha of farm land will lead to increases in the odds of the variable by 2.41 (0227885) and 2.17 (1817965) unites, respectively. The reason is not farfetched as increase in farming experience and farm size will reduce the dependency on agrochemical because the farmer would have over the years gathered knowledge on better ways of handling their farming activities. The result is in consistent with the findings of Adeola and Adetunbi (2015) who reported that there is a relationship between framing experience, farm size and pesticides use.

Membership of association and cost of seed have significant and positive relationship at 10% and 1% with awareness on agrochemical. This implies that a unit increase in association activities will translate into increase in the odds of agrochemical awareness by 1.75 (.1247753) while unit increase in the price of seed will lead 3.20 (.0000265) increase in the odds of agrochemical awareness this is because farmers might get to know how to treat and get the best

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out of their seed by learning from other association members which might make them depend less on agrochemical. The result is in agreement with the findings of Jianjun *et al.* (2012) who opined that belonging to association help farmers to gain more awareness on agrochemical there by reducing over use.

Furthermore, sources of information and labour have a significant but negative relationship with agrochemical awareness at 5% and 1%, respectively. This implies that a unite increase in these variables will lead to decrease in the odds of the above mentioned variable by -2.01 (-030938) and -2.80 (-.0197928) units, respectively. This could be to the fact that as maize farmers gets more information on agrochemical from different sources and engage competent hands in applying agrochemical; they will have better awareness on agrochemical use. The result is consistent with the findings of Franklin *et al.* (2017) who reported that more access to more information sources (television and radio) contributes significantly and are very effective in communicating to farmers who cannot read labels. The author also reported that smallholder maize farmers are more aware of agrochemicals use risk than large-scale farmers holding other factors constant which could be that large-scale farmers do not apply pesticides by themselves regularly and usually get this job done by hired labor.

Table 5: Marginal Effects Obtained from Probit Regression Result

Variables	dy/dx	Standard error	Z-value	P-value
Age (years)	-.0063278	.003073	-2.06	0.039
Farming Experience (years)	.0133448	.0052572	2.54	0.011
Farm size (Ha)	.044228	.0195652	2.26	0.024
Membership of association (Dummy)	.1247753	.0713235	1.75	0.080
Cost of seed (₦)	.0000265	8.30e-06	3.20	0.001
Sources of information (number)	-.030938	.0153795	-2.01	0.044
Labour (Mondays)	-.0197928	.0070781	-2.80	0.005

Source: Field survey (2019)

CONCLUSION AND RECOMMENDATIONS

Results of the study reported that maize farmers were majorly male, married with a mean age of 43 years; these were attributed to the tedious cultural practices involved in maize production. Also, respondents do not have adequate access to extension agents, thus, reducing their awareness on health risk associated with the use of agrochemical. It was discover that difficulty in breathing, chest pain, eye problem and sneezing top the health hazards table as perceived by the farmers. Majority of the farmers do not read agrochemical labels nor follow instruction before using them which could be attributed to their low level of education. Finally, it was discovered that increase in age, sources of information, labour reduces the odds of agrochemical health risk, while increase in farming experience, farm size, membership of association and cost of seed increases the odds of agrochemical health risk awareness. Based on these findings, it was recommended that:

1. Awareness campaigns and mass trainings on the use, handling and application of agrochemicals should be encouraged in order to achieve effective and safe use of agrochemicals by the farmers.
2. Governmental and non-governmental organizations should participate in increasing extension services in the study area in order to enlighten farmers on various precautionary measures to be taken while handing agrochemical.
3. Furthermore, farmers should be encouraged to join or form cooperatives societies as better relationships with other villagers helps to reduce agrochemical misuse.
4. Finally, women should be encouraged to take part in maize farming.

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