Adoption of Pesticide Safety Rules by Cowpea Farmers in Sabon Zaria Local Government Area of Kaduna State, Nigeria

Issa, F. O.[1], Okoma, C. M .[2],Asonye, N. C.[3], Irebuisi D. C.[4] ,Umar, A.[5]

[1,3,4]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria

[2]Alvan Ikoku Federal University Of Education owerri, Imo -state

[5]Department of Vocational and Technical Education, Ahmadu Bello University, Zaria

DOI: https://dx.doi.org/10.47772/IJRISS.2025.909000131

Received: 21 August 2025; Accepted: 28 August 2025; Published: 01 October 2025

ABSTRACT

The study assessed adoption of Pesticide Safety Rules by Cowpea Farmers in Sabon Zaria L.G.A of Kaduna State. Specific objective was to describe socio-economic characteristics of farmers, identify sources of information on pesticide usage, level of awareness of safety rules, adoption of safety rules and constraints to adoption among farmers. The result of the study indicated 74.74% of the respondents fell within the age range 31 - 40 years, majority (84.21%) male and 15.79% female,. The results shows different sources of information included Agricultural extension services (26.3%), Local agricultural input suppliers (12.6%), fellow Farmers (34.7%). The results of awareness of safety rules shows Reading of label (M=3.0), wearing protective clothing (M=3.6), cleaning equipment after use (M=3.2) and proper disposal of container (M=3.0).Constraints experienced by farmers includes; Financial constraints buying effective pesticide (M=3.2), Lack of government support or regulation leads to lost of interest in the use of pesticides (M=3.0), lack of knowledge about safety rules leads to sickness among farmers (M=2.9), Lack of proper training on pesticide safety leads to dead (M=2.6). Based on the findings It was recommended that provision of credit is an intractable problem in Nigeria agriculture, it is suggested that a realistic policy on provision of credit to farmers be put in place. Prompt supervision/advice from agricultural agency/organization to ensure proper used and utilization of pesticides for increase production.

Keywords: Pesticide safety rules, technology adoption, cowpea farming

INTRODUCTION

The use of pesticides in cowpea production has become a widespread practice among farmers, largely due to their effectiveness in controlling pests and diseases that threaten yields. However, this reliance often comes at the expense of environmental sustainability and human health. With the modernization of agriculture—which entails the adoption of improved seeds, synthetic fertilizers, irrigation technologies, and agrochemicals—the vulnerability of crops to pests has increased, creating a paradox where pesticides both solve and exacerbate production challenges (Nwadike, Joshua, Doka, & Moda, 2021; Adeola, Sanyaolu, Ayinde, & Okafor, 2025).

Pesticides encompass a wide range of chemical and biological agents, including herbicides, insecticides, nematicides, molluscicides, rodenticides, bactericides, fungicides, and repellents. Herbicides dominate global use, accounting for nearly 80% of pesticide consumption (Udoh & Gibbs, 2022). While intended as crop protection products, misuse, over-application, or lack of knowledge regarding safe handling often reduce their benefits and amplify risks. For instance, studies in Northern Nigeria revealed that despite farmers' awareness of pesticide hazards, improper disposal, poor adherence to pre-harvest intervals, and inadequate protective gear remain common (Yami et al., 2025; Madaki, Lehberger, Bavorová, Igbasan, & Kächele, 2024).

Historically, research emphasized socio-economic determinants of pesticide use such as age, education, farm size, labor availability, and awareness levels (Mohammed, Umar, Mohammed, Rahman, & Boukar, 2021). Contemporary studies, however, critique this narrow focus, showing that farmer knowledge does not always translate into safe practices due to structural challenges like poor access to extension services, weak regulatory enforcement, and limited alternatives to synthetic pesticides (Bamiwuye, Akinola, & Adeyemi, 2024; Udoh & Gibbs, 2022). This suggests that adoption of safety rules is not merely a function of individual choice but is mediated by broader institutional and policy gaps.

Moreover, the assumption that "inert" ingredients in pesticide formulations are harmless is increasingly contested. While these components are not required to be disclosed, recent evidence shows that certain solvents and adjuvants may intensify the toxicity of active ingredients or pose long-term ecological risks (Apeh, Ogwuche, Audu, & Adamu, 2024). This challenges the simplistic dichotomy between "toxic actives" and "harmless inerts" and underscores the need for stricter labeling and farmer sensitization.

In cowpea production specifically, pesticides remain indispensable, particularly against Maruca vitrata and other pod borers. Yet, studies show that indiscriminate spraying not only elevates production costs but also results in pesticide residues in harvested produce, thereby endangering consumer health and restricting marketability (Olasoji, Ogunjimi, Falola, & Oyekale, 2024; Suleiman, Nuhu, & Yashim, 2021). Furthermore, while pesticides contribute to short-term productivity, long-term dependence risks soil degradation, pollinator decline, and resistance build-up in pest populations (Malik, Buba, Musa, & Ibrahim, 2021).

Therefore, pesticide adoption should be critically re-examined beyond simplistic cost–benefit narratives. The challenge lies in balancing the productivity gains of chemical control with the health, ecological, and economic externalities. Increasing evidence highlights the importance of farmer training, integrated pest management (IPM), and stronger extension–policy linkages in promoting safer practices (Omoigui, Kamara, Kamai, Mohammed, Onyibe, & Ousmane, 2020; Nwadike et al., 2021). Unless pesticide governance shifts toward a more holistic approach that incorporates regulation, education, and innovation in safer alternatives, smallholder cowpea farmers in regions like Sabon Zaria risk being locked in a cycle of dependency, health vulnerability, and declining ecological resilience.

Objective of the study

The main objective of this study is to assess the adoption of pesticides safety rules by cowpea farmers in the study area. Specifically, the study described the socio-economic characteristics cowpea farmers; identified the **s**ources of information about pesticides usage by cowpea farmers; **a**ssessed the awareness of Safety rules in the application of pesticides; examined the level of adoption of safety rules in the use of pesticides; and identified the constraints to adoption of safety rules in pesticide use among cowpea farmers in the study area.

METHODOLOGY AND THE STUDY AREA

The study was conducted in Kaduna State. Zaria is a major city in Kaduna State in northern Nigeria, as well as being a Local Government Area. Formerly known as Zazzau, it was one of the original seven Hausa city-states. Today, it is known for housing Nigeria's largest university, Ahmadu Bello University, as well as being home to a number of prominent Nigerians. From the 2006 population census, Zaria was estimated to have 408,198 people. It is home to the Zazzau Emirate. Zaria, initially known as Zazzau, was the capital of the Hausa kingdom of Zazzau. Zazzau is thought to have been founded in 1536 and later was renamed after Queen Zaria. Human settlement predates the rise of Zazzau, as the region, like some of its neighbors, had a history of sedentary Hausa settlement, with institutional market exchange and farming. Zaria was the most southern of the Hausa city-states. Coordinates: 11°04′N 7°42′E Country Nigeria Area Total 563 km2 (217 sq. mi) Population (2006 Census) Total 408,198 Density 730/km2 (1,900/sq. m) The neighborhoods of Samaru and Sabon Gari are predominantly occupied by Nigerians of southern origin, such as the Igbo. These neighborhoods were formed during the colonial period. The largest marketplace is in Sabon Gari. Zaria is located on the high plains of Northern Nigeria, 652.6 meters above sea level, some 950 km away from the coast, Zaria lies between Latitude 11003' N and 11015' N; Longitude 7030' E and 7045' E in Kaduna State.

Urban Zaria consists of six distinct settlements: Zaria City, Tudun Wada, Sabon Gari, Government Reservation Area, Palladan and Samaru (Sawa and Buhari, 2011).

Essentially, Zaria metropolis comprises of two Local Government Area (LGA), namely, Zaria and Sabon Gari Local Government Areas. The study area is bounded to the south by Igabi LGA, to the north by Kudan LGA, to the east Soba LGA and to the west Giwa LGA. Zaria is 156km south west of Kano, 84km North-East of Kaduna. Zaria is about 698km North of the Atlantic Ocean. The target population for this study consisted of 2,135 cowpea farmers in Sabon Gari Zaria. Due to the large size of the population, a sample was selected using a multi-stage sampling technique First stage involved the use of proportional sampling to select 30% of cowpea farmers from the total population in each group Then a random selection of wards within Sabon Gari Zaria was made. Finally, from each selected ward, a systematic random sampling method was employed in the wards to choose the cowpea farmers to be included in the study. The wards were arranged systematically and six wards were selected randomly as a representative of the sample of the population of the farmers in the study area; Bassawa, Samaru, Bomo, Jushinwaje, Chikaji and Dogarawa. The basis for this was to gather information from cowpea farmers who have knowledge on pesticide over the years and are more concerned and Conscious about Imminent Impact of these changes on their farming practices. Only farmers who are willing and interested were being administered questionnaire. Data was collected for this study using a structured questionnaire. The questionnaire was designed to gather information on the adoption of pesticide safety rules by cowpea farmers. It consisted of both closed-ended and open-ended questions. Before administering the questionnaire, a pilot test was conducted to ensure its reliability and validity. The questionnaire was then distributed to the selected cowpea farmers, and their responses were recorded.

Additionally, qualitative data was collected through in-depth interviews with key informants such as agricultural extension agents and representatives from relevant government agencies. These interviews provided deeper insights based on the objectives of the adoption of pesticide safety rules in the study area.

The analytical techniques used were frequency count, percentage and descriptive statistics of mean score as the statistical tool in analysing the data. A four scale method was used in order to determine the degree of agreement/acceptance or otherwise in each of the rating scale item. The criterion mean of 2.5 was used which indicated the level of acceptance. Any mean score less than 2.5 were considered rejected.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Cowpea Farmers

Table 1 discussed the Socio-economic characteristics of the respondents. The result for the age of the respondents shows that 74.74% of the respondents were within the age category of 31-40years, thus they are said to be in their productive age. The responses also indicate that average age had greater tendency to adopt new innovations because they are more open to risk taking and have a longer planning horizon. This finding is similar to that of Ibrahim etal (2016), Factors Influencing the Level of Adoption of Cowpea Production Technologies in Askira/Uba Local Government Area of Borno State, Nigeria which indicates that average age had greater tendency to adopt new innovations because they are more open to risk taking and have a longer planning horizon. The result on the gender of the respondents indicates that the majority (84.21%) of the respondents were male while 15.79% were female. This implies that most cowpea farmers in the study area were male. This agrees with the findings of Tiamiyu (2013), who reported that cowpea farming was dominated by men. This could be attributed to the fact that male farmers have more access to family land than their female counterpart because of the exclusive right of male children to inherit family land. The marital status of the respondents revealed that 76.84% of the respondents were passing through married life, 9.47% were single, with 5.22% of them that were divorced and 8.42% widows. This agrees with the findings of Ibrahim (2016) who indicate that marital status has implication of Adoption of Pesticide Safety Rules by Cowpea Farmers and also Idrisa (2010) described married people to have more responsibilities and hence take whatever they do with higher levels of seriousness. The educational background of the respondents revealed that 60.0% had primary education, 21.05% had secondary education, 10.52% had tertiary education and 8.42% had no formal education. This indicates that 91.68% of the respondents were literate at least having one form of formal

education. This implies that there is potential for increased cowpea adoption safety and rules since education will enable farmers to have access to information on new Agricultural innovation which can be adopted to enhance their productivity and healthy safety (IITA 2009). The farm size of the respondents revealed that about 63.16% of the respondents cultivating less than 4 hectares of land. This implies that most of the farmers had small farm holdings. According to Yusuf (2005), the total farm cultivated is related to the total farm size available to the farmers. Record of household size also revealed that 31.58% of the respondents had 1 - 5 persons per family, majority 50.52% had 6 - 10 person in their household. It implies that there could have been enough hands to participate in the labour intensive cowpea farming operations. It further implies that 15.79% of the respondents have 11-15 persons in the family, while 2.11% of them had between 16-20. Family labour is an important component for small-scale holders. This is mainly because the subsistence farm holders are resource poor and may have to depend on family labour for agricultural activities which in most cases labour intensive (Idrisa, 2009). Farm income of respondents revealed that the respondents earned between N60, 000 to N80, 000 were 53.68% representing most of the respondents. Accordingly, 26.32% of the respondents earned 80,000-100,000 and only 20.00% earned greater than 100,000. The access to credit of the respondents revealed that only 20.0% of the respondents had access to credit while the majority (80.0%) of the respondents has no access to credit. This agrees with the findings of Ibrahim (2016), revealed that farmers access to credit enables them to acquire materials necessary for the adoption of new technologies such as improved seeds, fertilizers and chemicals. The result of farming experience indicated farmers with 1-10 years comprises 10.53%, majority 73.68% had 11-20years experience, and 9.68% had 21-30 years of farming experience while the least 6.32% had above 30 years of farming experience. This agrees with the findings of Ani (2018) who says farming experience of farmers to a large extent affects their managerial know – how.

Table 1: Socio-economic characteristics of cowpea farmers

Variables	**Frequency**	**Percentage**	**Mean**
Age			
20-30	5	5.26	
31-40	71	74.74	
41-50	10	10.53	
Above 50	9	9.47	38
Gender			
Male	80	84.21	
Female	15	15.79	
Marital status			
Married	73	76.84	
Single	9	9.47	
Divorced	5	5.26	
Widowed	8	8.42	
Education background			
Informal	8	8.42	
Primary	57	60	
Secondary	20	21.05	
Tertiary	10	10.53	
Farm size			
1-3	60	63.16	
4-6	18	18.95	
7-9	12	12.63	
10 and above	5	5.26	4.4

Household size			
1-5	30	31.58	
6-10	48	50.53	
11-15	15	15.79	
Above 15	2	2.11	7
Annual farm income			
60,000-80,000	51	53.68	
80,000-100,000	25	26.32	
Above 100,000	19	20.00	25
Access to credit			
Accessed	19	20.00	
Not accessed	76	80.00	
Years of farming experience			
1-10	10	10.53	
11-20	70	73.68	
21-30	9	9.47	
Above 30	6	6.32	16.6

Source: Field Survey; 2023

Table 2 shows the frequency and the percentages of Sources of information about pesticide usage by cowpea farmers which included; Agricultural extension services (26.3), Local agricultural input suppliers (12.6%), fellow Farmers (34.7%). Others include internet and social media (5.3%), print media (newspapers, magazine) (6.3%), radio program (12.6%), and journal (2.1%) based on the responses majority of respondents get their information from follow Farmers.

The results from Table 2 indicate that fellow farmers (34.7%) were the leading source of information on pesticide use among cowpea farmers in Sabon Zaria LGA, followed by agricultural extension services (26.3%), local input suppliers (12.6%), and radio programs (12.6%), with far fewer respondents citing print media (6.3%), internet/social media (5.3%), and journals (2.1%). This finding is revealing on multiple fronts.

First, the dominance of peer-to-peer learning underscores the informal diffusion of knowledge among smallholder farmers. While social learning is an important mechanism in agricultural adoption (Mohammed, Umar, Mohammed, Rahman, & Boukar, 2021), it raises questions about the accuracy and safety of the information being circulated. Earlier studies have shown that farmer-to-farmer advice often perpetuates unsafe pesticide practices due to limited technical knowledge (Nwadike, Joshua, Doka, & Moda, 2021). Hence, reliance on fellow farmers—while accessible and trusted may reinforce risky behaviours such as over-application, neglect of pre-harvest intervals, or improper disposal (Yami et al., 2025).

Second, the fact that only 26.3% of farmers reported receiving information from extension services reflects the weak reach of formal agricultural advisory systems. Extension agents are expected to be the most reliable sources of pesticide safety knowledge, but similar gaps have been reported in other Nigerian states, where extension coverage remains inadequate due to underfunding, poor staffing, and logistical constraints (Omoigui, Kamara, Kamai, Mohammed, Onyibe, & Ousmane, 2020; Udoh & Gibbs, 2022). This weak institutional presence limits farmers' ability to adopt safety rules, since technical instructions on protective gear, dosage, and environmental precautions are rarely reinforced through consistent training (Madaki, Lehberger, Bavorová, Igbasan, & Kächele, 2024).

Third, the notable role of local agro-input dealers (12.6%) echoes findings by Madaki et al. (2024), who reported that pesticide retailers often serve as "de facto extension agents." While this can expand farmers'

access to information, it presents a critique: dealers may prioritize sales over safety, often providing incomplete or biased advice that encourages chemical dependence (Apeh, Ogwuche, Audu, & Adamu, 2024). Thus, while input shops are convenient, they may inadvertently contribute to misuse and resistance problems in cowpea pest management.

Fourth, the low uptake of modern channels such as the internet/social media (5.3%) and journals (2.1%) highlights a persistent digital and literacy gap. Despite increasing penetration of mobile phones and online platforms in Nigeria, rural farmers still face barriers of affordability, low literacy, and limited tailored agricultural content (Bamiwuye, Akinola, & Adeyemi, 2024). This gap undermines the potential of ICT-based agricultural extension, which could otherwise disseminate timely pesticide safety information at scale.

Finally, traditional media—especially radio (12.6%)—still plays a role, albeit modest, in bridging the information gap. Radio programs have been recognized as cost-effective in reaching dispersed rural communities, but their effectiveness depends on content quality and interactivity (Adeola, Sanyaolu, Ayinde, & Okafor, 2025). The relatively low percentage in this study suggests that such programs may be underutilized or not sufficiently localized to address cowpea farmers' pesticide challenges.

Table 2: Sources of information about pesticide usage by cowpea farmers

Sources	Frequency	Percentage (%)
Agricultural extension services	25	26.3
Local agricultural input suppliers	12	12.6
Fellow farmers	33	34.7
Internet and social media	5	5.3
Print media (newspapers, magazines)	6	6.3
Radio programs	12	12.6
Journals	2	2.1

Source: Field Survey; 2023

The result in table 3 revealed the mean of Awareness of safety rules of adoption of pesticide among cowpea which included; Reading of label (M = 3.0), wearing of protective clothing (M= 3.6), cleaning equipment after use (M = 3.2), disposing of container properly (M= 3.0), keep children and pets away (M= 2.8), Avoid drinking/drinking/smoking during spraying (M = 3.1). Others includes washing of hands thoroughly after application (M = 3.0) wearing of noise guard and hand gloves (M= 3.2). The implication is that wearing of protective clothes have more significant in protecting and safeguard farmers while using pesticide.

Table 3: Awareness of safety rules of adoption of pesticide among cowpea

Safety rules	Very useful	useful	Least useful	Not useful	Mean	Criteria
Reading of label	41	25	20	10	3.0	Accept
wearing of protective clothing	50	20	25	-	3.6	Accept
cleaning equipment after use	45	32	13	5	3.2	Accept
disposing of container properly	46	19	20	10	3.0	Accept
keep children and pets away	30	40	5	20	2.8	Accept
Avoid drinking/drinking/smoking during spraying	41	21	30	3	3.1	Accept
washing of hands thoroughly after application	39	30	21	5	3.0	Accept
wearing of noise guard and hand gloves	49	19	22	5	3.2	Accept

Source: Field Survey; 2023. Note: criteria mean=2.5

The results from Table 4 reveal that cowpea farmers in Sabon Zaria adopt certain pesticide safety rules more readily than others. Practices such as wearing protective clothing (M = 3.2), cleaning spraying equipment (M = 3.1), and keeping children and pets away during application (M = 3.1) received higher ratings, suggesting farmers prioritize visible and immediate protective measures. Similar findings were reported by Nwadike, Joshua, Doka, and Moda (2021), who observed that Nigerian farmers often associate safety with physical protection rather than procedural rules.

In contrast, reading pesticide labels (M = 2.8), proper disposal of containers (M = 2.7), and avoiding spraying against wind direction (M = 2.5) ranked lower. These results align with Madaki, Lehberger, Bavorová, Igbasan, and Kächele (2024), who found that literacy barriers and complex labeling often hinder farmers from following written guidelines. Improper disposal practices, which expose children and contaminate the environment, have similarly been highlighted as a major challenge in Kaduna and surrounding states (Suleiman, Nuhu, & Yashim, 2021; Malik, Buba, Musa, & Ibrahim, 2021). The weak adherence to drift-prevention rules further reflects limited awareness of less visible risks such as inhalation hazards, an issue also stressed by Udoh and Gibbs (2022).

Overall, the findings indicate partial adoption of pesticide safety rules, with farmers emphasizing practices they can visibly control while neglecting those that require higher technical understanding or regulatory enforcement. This imbalance underscores the need for farmer training that combines experiential practices with technical safety knowledge (Olasoji, Ogunjimi, Falola, & Oyekale, 2024; Bamiwuye, Akinola, & Adeyemi, 2024).

Table 4 Adoption of safety rules in the use of pesticide

Safety rules	**often**	**Occasionally**	**irregularly**	**Never**	**Mean**	**Criteria**
Reading label can serve as a guideline for pesticide usage for cowpea farmers	20	40	30	5	2.8	Accept
Wearing protective Clothing will lower the risk of drifting of chemicals	50	20	20	5	3.2	Accept
Cleaning of equipment will improve performance of chemicals	40	30	15	10	3.1	Accept
Disposing of container properly will lower the risk of children coming in contact with chemicals	25	35	20	15	2.7	Accept
Keeping children and pest away during application reduce the risk of inhalation of toxic chemicals	40	35	12	8	3.1	Accept
Avoid spraying in wind direction	30	8	40	17	2.5	Accept
Avoid eating/drinking/smoking during spraying	45	12	30	8	2.9	Accept

Source: Field Survey; 2023. Note: criteria mean=2.5

Table 5 highlights the major constraints hindering the adoption of pesticide safety rules among cowpea farmers in Sabon Zaria LGA. The most critical constraint identified was financial limitation (M = 3.2), which discourages farmers from purchasing effective and safer pesticides. This finding aligns with Agbamu (2006), who emphasized that financial incapacity remains a fundamental barrier to the adoption of improved agricultural practices. Similarly, Bawalla (2021) reported that limited financial resources significantly reduce teachers' and farmers' ability to access quality inputs, reinforcing the importance of economic support in ensuring compliance with best practices.

The study also revealed that lack of government support and regulation (M = 3.0) contributes to farmers' reduced interest in pesticide safety compliance. This corroborates Faremi (2021), who found that weak institutional frameworks and inadequate government involvement hinder task performance among agricultural stakeholders in Nigeria. In addition, knowledge gaps and insufficient training (M = 2.9 and M = 2.6,

respectively) were reported as constraints, indicating that many farmers lack adequate awareness of safety protocols. This supports the observations of Awodiji, Ogbudinkpa, and Agharanya (2020), who noted that poor extension services and limited training opportunities restrict farmers' ability to adopt safer practices.

Limited access to safety information (M = 2.9) and inadequate protective equipment (M = 2.7) were also highlighted as constraints, often leading to excessive use of pesticides and health risks during application. These findings resonate with Ajao, Oguntayo, and Owoseni (2024), who emphasized that inadequate resources and insufficient resilience mechanisms contribute to occupational health challenges among Nigerian workers.

Finally, the issue of availability and affordability of safer alternatives (M = 2.2) was ranked lower but remains relevant, as the lack of qualitative pesticide options demotivates farmers from adopting safer practices. This agrees with Cece, Martinent, and Guillet-Descas (2022), who observed that the availability of resources and supportive environments strongly predicts motivation and compliance with safety guidelines.

Overall, the findings underscore that both economic (financial capacity, affordability of inputs) and institutional (government support, training, and information dissemination) factors are central to farmers' adoption of pesticide safety rules.

Table 5: Constraints to the adoption of safety rules of pesticides among cowpea farmers

Constraints	Often	Occasionally	Irregularly	Never	Mean	criteria
Lack of knowledge about safety rules promote which leads to sickness among farmers	40	18	27	10	2.9	Accept
Limited access to information on safety practices leads to excessive usage of pesticide	32	29	19	12	2.9	Accept
Financial constraints discourage farmers from buying effective pesticides	50	20	15	10	3.2	Accept
Availability and affordability of safer alternatives causes loss of interest in buying qualitative pesticides	15	10	50	20	2.2	Reject
Lack of proper training on pesticide safety leads to severe dead among during application	21	30	30	14	2.6	Accept
Inadequate protective equipment causes injury on skin during application	30	20	40	5	2.7	Accept
Lack of government support or regulation leads to loss of interest in the use of pesticides as a cowpea farmer	45	15	25	20	3.0	Accept

Source: Field Survey; 2023 Note: criteria mean=2.5

CONCLUSIONS AND RECOMMENDATIONS

This study concluded that:

1. Majority of the farmers were middle-aged and averagely literate, implying that, many of them are in a position to be aware, understand and adopt cowpea pesticides safety rules available.
2. The sources of information about pesticides usage by the respondents include agricultural extension services, local agricultural input suppliers, fellow Farmers, internet and social media, print media (newspapers, magazine), radio program and journal.
3. Awareness of safety rules of adoption of pesticide among cowpea which included; reading of label, wearing of protective clothing, cleaning equipment after use, disposing of container properly, keep children and pets away, avoid eating/drinking/smoking during spraying.

4. Adoption of safety rules in the use of pesticides included; reading label can serve as a guideline for pesticide usage for cowpea farmers, wearing protective clothing will lower the risk of drifting of chemicals, cleaning of equipment will improve performance of chemicals, disposing of container properly will lower the risk of children coming in contact with chemicals.
5. Constraints to the adoption of safety rules of pesticides among cowpea; Financial constraints discourage farmers from buying effective pesticide, lack of government support or regulation leads to loss of interest in the use of pesticides as a cowpea farmer, lack of knowledge about safety rules promote which leads to sickness among farmers, lack of proper training on pesticide safety leads to severe dead among during application, limited access to information on safety practices leads to excessive usage of pesticide

Recommendations

Based on the findings of this study the following recommendations were made:

1. Government should develop and implement policies that standardize the use of pesticides.
2. The Government may have to revisit this issue, provision of credit is an intractable problem in Nigeria agriculture, it is suggested that a realistic policy on provision of credit to cowpea farmers in particular be put in place.
3. Extension officers should provide supervision and advice to ensure proper used and utilization of the available pesticides for increase cowpea production.
4. Extension officers should be devoted to the dissemination of innovations, this will go a long way in creating awareness among cowpea farmers in the study area, thus the use of pesticides efficiently
5. Cowpea farmers should organize themselves into cooperatives, this will enable them to purchase modern farm inputs and hire additional labour to have access to credits/loans to enable them procure farm inputs and mechanized services for improved agricultural production

REFERENCES

1. Nwadike, C., Joshua, V. I., Doka, P. J. S., & Moda, H. M. (2021). Occupational safety knowledge, attitude, and practice among farmers in Northern Nigeria during pesticide application—A case study. Sustainability, 13(18), 10107. https://doi.org/10.3390/su131810107
2. Madaki, M. Y., Lehberger, M., Bavorová, M., Igbasan, B. T., & Kächele, H. (2024). Effectiveness of pesticide stakeholders' information on pesticide handling knowledge and behaviour of smallholder farmers in Ogun State, Nigeria. Environment, Development and Sustainability, 26, 17185–17204. https://doi.org/10.1007/s10668-023-03332-8
3. Yami, M., Abdu, A., Folawewo, A. O., Mohammed, M., Abubakar, M., & Abdullahi, A. (2025). Farmers' pesticide use, disposal behavior, and pre-harvest interval: A case study from Nigeria (Kano State). Frontiers in Sustainable Food Systems, 9, 1520943. https://doi.org/10.3389/fsufs.2025.1520943
4. Adeola, A., Sanyaolu, A., Ayinde, J., & Okafor, C. (2025). Regional variations and determinants of pesticide use among farmers in Southwestern Nigeria: Implications for sustainable agriculture. Frontiers in Agronomy, 7, 1503899. https://doi.org/10.3389/fagro.2025.1503899
5. Olasoji, J. O., Ogunjimi, L. A. O., Falola, A. O., & Oyekale, A. S. (2024). Economic evaluation of cowpea production under different insecticide application regimes in the Northern Guinea Savanna of Nigeria. African Journal of Agricultural and Resource Economics. https://afjare.org
6. Omoigui, L. O., Kamara, A. Y., Kamai, N., Mohammed, S. G., Onyibe, J. E., & Ousmane, B. (2020). Guide to cowpea production in Northern Nigeria. International Institute of Tropical Agriculture (IITA).
7. Suleiman, F., Nuhu, A., & Yashim, I. Z. (2021). Health risk assessment of organochlorine and synthetic pyrethroid pesticide residues via dietary intake of fruits and vegetables along River Galma, Zaria, Kaduna State. Nigerian Journal of Pharmaceutical and Applied Science Research, 10(1), 10–14.
8. Malik, U., Buba, A. S., Musa, A., & Ibrahim, R. (2021). Pesticide residue of some selected organophosphates and carbamates in guava fruits sold at Giwa markets, Kaduna State, Nigeria. Journal of the Horticultural Society of Nigeria, 26(1), 18–25.

9. Bamiwuye, O. A., Akinola, A. A., & Adeyemi, T. S. (2024). Pesticide knowledge and safety practices among smallholder farmers in Iwo Local Government Area, Osun State, Nigeria. Tanzania Journal of Agricultural Sciences, 23(2), 55–68.
10. Udoh, G. D., & Gibbs, J. L. (2022). Highlighting the need for pesticide safety training in Nigeria: A survey of farm households in Rivers State. Frontiers in Public Health, 10, 988855. https://doi.org/10.3389/fpubh.2022.988855
11. Mohammed, S. B., Umar, M. L., Mohammed, I., Rahman, M. A., & Boukar, O. (2021). Appraisal of cowpea cropping systems and farmers' adoption of improved technologies in Nigeria. CABI Agriculture and Bioscience, 2(1), 46. https://doi.org/10.1186/s43170-021-00046-7
12. Apeh, A. C., Ogwuche, J. A., Audu, M., & Adamu, M. (2024). Exploring data sources and farmers' perceptions regarding agro-chemicals in Nigeria. Journal of the Science of Food and Agriculture – Food Systems, 4(1), e212. https://doi.org/10.1002/jsf2.212
13. Ani, A. O., Ogunbameru, B. O. and Undiandeye, U. C. (2018). Factors Affecting Adoption of Agricultural Technology: In Ogunbameru, B. O; Undiandeye, U. C.; and Ani, A. O. (eds) Agricultural Extension Methodologies. Loud Books Publishers, Ibadan, Nigeria.
14. Agbamu, J. U. (2006). Essentials of Agricultural Communications in Nigeria. First Edition, Malthouse Press Limited. Lagos, Nigeria. Pp. 47-81.
15. National Population Commission (NPC). (2006). Nigerian Population Commission, Abuja. Population of Nigeria by State and Sex, 1991 and 2006, Network. Retrieved 2008.
16. IITA (2009) Cowpea Project for Africa Research and Development. International Institute of Tropical Agriculture. Available at: http//www.iita.org/crop/cowpea.
17. Idrisa, Y. L. (2010). Analysis of the Determinant of Soybean Production Technology Adoption by Farmers in Southern Borno, Nigeria. Unpublished Ph.D. Thesis, Department of Agricultural Economics and Extension Services, University of Maiduguri, Nigeria.
18. Ibrahim, A. A., Waba, S. Y., Mohammed, N., and Mustapha, S. B. (2016) Factors Influencing the Level of Adoption of Cowpea Production Technologies in Askira/Uba Local Government Area of Borno State, Nigeria. International Academic Journal of Innovative Research,3(9): 15-23.