Assessment of farmers’ utilization of approved pesticides in cocoa farms in Ondo state, Nigeria

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ABSTRACT

The study assessed farmers’ utilization of approved pesticides in cocoa farms in Ondo State, Nigeria. A multi-stage sampling procedure was used to select 240 respondents for the study. Data were collected using an interview schedule and analyzed using descriptive and inferential statistics. The results revealed that most (91.2%) of the respondents were male, married (90.0%) with a mean age of 51.1 years. The major insecticide approved by the Cocoa Research Institute of Nigeria (CRIN) and utilized by the majority of the cocoa farmers was Actara 25 WG. The major approved fungicide by CRIN and utilized by cocoa farmers were Ridomil Gold, Ultimax Plus, and Red Force. The results further showed that Clear Weed was the most used herbicide among the approved herbicides recommended to the cocoa farmers in the study area. Results further revealed that all (100.0%) cocoa farmers complied with the safety precautions of using pesticides. These precautions include: avoid mixing herbicides with fungicides, avoid spraying against wind direction, and proper handling and storage of pesticides. The major constraints faced by cocoa farmers in using the approved pesticides were lack of government support in terms of grants and inputs (X̄ = 2.97), lack of access to credit facilities (X̄ = 2.95), and high cost of approved pesticides (X̄ = 2.90). The education status of cocoa farmers had a significant association with compliance with safety precautions while using pesticides (χ² = 6.087, p ≤ 0.05). The study recommends that cocoa farmers should be assisted with timely provision of approved cocoa pesticides by government, non-governmental agencies and private organizations.

1. Introduction

Agriculture is the main engine that enhances economic processes in national development (Ojong and Anam 2018). Historically, agriculture was the mainstay of Nigeria's economy in the 1970s before the oil boom (Ayodele et al., 2013). Agricultural products like cocoa, oil palm, palm kernel, rubber, and groundnut, among many other cash crops, were viewed as of great economic value in Nigeria. The accrual from the exports serves as a core source of revenue generation for the government. This was when Nigeria was called food secured, self-sufficient in food production with a surplus for export (Otaha 2013).

Cocoa is a vital component of African agriculture, contributing significantly to farmer profits. Cocoa plays a crucial role in preserving biodiversity and sound natural resource management and providing additional mechanisms for the diversification and intensifying food crop systems. The relevance of cocoa to most developing economies cannot be overemphasized, as cocoa is grown in more than fifty developing countries throughout Asia, Africa, and Latin America, many of which are located in tropical or semi-tropical climates (Oluyole 2017).

Despite cocoa’s tremendous potential as a major foreign exchange earner and job opportunities and household income development, it was abandoned in favour of oil, causing the cocoa economy to plunge. According to CRIN (2010), the abandonment of farms, aging farmers, old farms, pests, and diseases, are all serious factors affecting cocoa production in Nigeria. Cocoa farmers used agrochemicals such as pesticides and fertilizers to tackle these various problems associated with cocoa production (Aminu and Edun 2019).

The World Health Organization (WHO) and the European Union (EU) have banned some of these pesticides due to their high toxicity levels. The ban took effect in September 2008, and all cocoa-producing countries were required to comply with EU regulations or face sanctions. Pesticides that have been banned are common in local markets, are used in different parts of society, and are considered possible risks to the environment and health. The abuse of these pesticides has been more prevalent in the rural areas of developing countries (Aliyu and Majeti 2020).

The Cocoa Research Institute of Nigeria (CRIN) has a national mandate to screen pesticides for efficacy and low environmental toxicity

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before using them on cocoa farms. The approved pesticides include; Insecticides (Actara 25WG, Esiom 150 SL, Proteus 170 O-TEC); Fungicides (Funguran-OH, Champ DP, Ridomil gold 66 WP, Copper Nordox 75 WP, Ultimax Plus, Kocide 2000, Kocide 101, Cabrio Duo, Red Force, Pergado); Herbicides (Touch down, Clear weed, Roundup), and Fumigant (Phostoxin) (CRIN 2019).

Despite these efforts, recommended pesticides practices (such as appropriate application techniques, the use of genuine products, proper calibration of equipment, ensuring personal health and safety, and environmental safety) have been poorly adopted, resulting in pesticides failure, environmental hazards, and health hazards (Olowogbon et al. 2013). Based on the above scenario, assessing farmers’ utilization of approved pesticides in cocoa farms in Ondo State, Nigeria, becomes imperative.

2. Materials and methods

2.1. The study area

The research was conducted in Ondo State, located in the South-west geopolitical zone of Nigeria. Agriculture is the people’s primary profession, with farming employing many labour forces. Cocoa is the dominant cash crop grown in the state. Other crops cultivated for domestic consumption include yam, cassava, and palm produce.

2.2. Sampling techniques and data collection

A multi-stage sampling procedure was employed to select respondents for this study. The first stage involved the purposive selection of four (4) local government areas out of the eighteen (18) LGAs because they are among the major cocoa producers in the state. They include Idanre, Ile-Oluji/Okeigbo, Ondo East, and Owo Local Government Areas as shown in Figure 1. The second stage involved the purposive selection of three (3) communities from each of the selected LGAs among the cocoa-producing communities where information on approved pesticides were disseminated to cocoa farmers. Hence, a total of twelve (12) communities were selected. The third stage involved a purposive selection of twenty (20) cocoa farmers who received information on approved pesticides from CRIN through the extension agents from each of the twelve (12) communities. In all, a total of 240 cocoa farmers constituted the sample size for the study. The primary data was collected using a pre-tested, and well-structured interview scheduled on the socio-economic characteristics of the respondents, level of utilization of CRIN approved pesticides, compliance with safety precautions in using approved pesticides, and the constraints in using the approved pesticides.

The instrument was pre-tested among cocoa farmers in Akure South Local Government Area of Ondo State. The reliability was determined using split half (Cronbach’s coefficient) reliability. The coefficients of

Figure 1. Map of Ondo State showing the study area. Source: Ondo State web portal, (2019).
split half for sections of the instrument that has scale revealed an alpha coefficient of 0.79 for level of compliance with safety precautions, and constraints faced in using approved pesticides had an alpha coefficient of 0.86. This implies that each section of the instrument tested were reliable.

3. Data analysis

The data collected were coded, entered, and then analyzed using SPSS version 21 (SPSS Inc., Chicago, IL, USA) and Microsoft Office Excel 2013 (Microsoft Corporation, Redmond, WA, USA). Descriptive results were expressed as frequencies, mean statistics, and percentiles, while the inferential statistics included chi-square.

4. Results and discussion

4.1. Socio-economic characteristics of respondents

Data presented in Table 1 shows the socio-economic characteristics of the respondents. The socio-economic characteristics include age, sex, marital status, level of education, household size (number of persons), farm sizes (hectares), and fund sources for cocoa production.

The results in Table 1 indicate that 31.7% of the respondents were between 51–60 years of age, while 30.4% of the respondents were between 41 and 50. The respondents’ mean age was 51.1 years. This implies that the cocoa farmers were getting older but still within their active age for production. This result corroborates the findings of Oladoyin and Aturum (2022) that the average age of cocoa farmers in Ibanre Local Government area of Ondo State was 55 years. Omoare et al. (2016), in their findings, also revealed that the average age of cocoa farmers in Ogun and Ondo State was 52.8 years.

Table 1 shows that 91.2% of the respondents were male, and only 8.8% were female. This implies that the male gender dominates cocoa farming in the area. This may be due to the labour-intensive nature of cocoa farming, especially the spraying of pesticides. The results confirm the findings of Osarenren et al. (2016), who found that the majority (88.9%) of cocoa farmers in Edo State were male.

Table 1 also reveals that most (90.0%) of the respondents were married, 5.8% were widowed, 2.1% were single, 1.7% were separated, and 0.4% were divorced. This indicates that marriage is an institution that is highly valued in most African countries, especially in rural areas. This result agrees with Awoyemi and Aderinoye-Abdulwahab (2019) that most cocoa farmers were married (97.2%). Since married people are seen as responsible and mature, marriage plays a significant role in influencing an individual's behaviour in the rural area to positively adhere to societal expectations (Akinmusola et al. 2016).

Table 1 shows that most respondents (90.4%) had received some education. Only a small proportion (9.6%) of the respondents had no formal education. This finding indicates that the majority of cocoa farmers were literate. This could influence their knowledge of the usage of approved pesticides as most farmers could read and understand chemicals instruction manuals and some literature on pesticide preventive measures. The result corroborates the findings of Awoyemi and Aderinoye-Abdulwahab's (2019) in the research carried out in Ekiti State that most cocoa farmers were educated. Farmers with a higher level of education can better interpret and synthesize complex agricultural information and are more responsive to innovations pushed to them than those with a lower level of education or none at all (Mokgadi and Oladele 2013).

The distribution of respondents by household size, as shown in Table 1, reveals that more than half (53.3%) of the respondents had a household size of 1-4 persons, and 41.7% of the respondents had a household size of 5-8 persons. The average household consists of 6 persons. This was in line with the results of Awoyemi and Aderinoye-Abdulwahab (2019) that cocoa farmers had a large household size of 7 persons. According to Omoare and Oyediran (2015), large households are important in rural communities because they provide human resources for farm and other household activities.

Table 1 indicates that most respondents (87.1%) had farms ranging from 1–5 ha, while 11.7% had 6–10 ha of land used for cocoa production. The mean farm size was 3 hectares. This means that the vast majority were small-scale farmers. The results aligned with Owoibi and Okunola’s (2015) findings in the research carried out in Ekiti State that the average farm size of Cocoa farmers was 2.5 ha. This result also supports the findings of Agbongbajahuoyi et al. (2013) that the mean farm size of cocoa farmers was 2.59 hectares.

The results in Table 1 show that most (68.8%) of the respondents depended on their savings as their source of funds for financing their cocoa production, while 18.3% depended on family members for their source of funds for cocoa production. Only very few (1.2%) of the respondents depended on Bank loans as their source of funds for cocoa production. This implies that cocoa farmers’ most important fund source was their savings. The results support the findings of Adebiyi and Okunola (2013) in the research carried out in Oyo State, which showed that a larger percentage (73.3%) of the cocoa farmers depended on their savings as their source of finance while only 2.0% obtained a loan from

| Variables                  | Frequency | Percentage | Mean |
|----------------------------|-----------|------------|------|
| Age (Years)                |           |            |      |
| ≤30                        | 8         | 3.3        |      |
| 31-40                      | 39        | 16.3       |      |
| 41-50                      | 73        | 30.4       |      |
| 51-60                      | 76        | 31.7       | 51.1 |
| 61-70                      | 38        | 15.8       |      |
| 71 and above               | 6         | 2.5        |      |
| Sex                        |           |            |      |
| Male                       | 219       | 91.2       |      |
| Female                     | 21        | 8.8        |      |
| Marital Status             |           |            |      |
| Single                     | 5         | 2.1        |      |
| Married                    | 216       | 90.0       |      |
| Divorced                   | 1         | 0.4        |      |
| Widowed                    | 14        | 5.8        |      |
| Separated                  | 4         | 1.7        |      |
| Level of Education         |           |            |      |
| No Formal Education        | 23        | 9.6        |      |
| Primary School Attempted   | 17        | 7.1        |      |
| Primary School Completed   | 22        | 9.2        |      |
| Secondary School Attempted | 51        | 21.2       |      |
| Secondary School Completed | 86        | 35.8       |      |
| Tertiary Education         | 41        | 17.1       |      |
| Household Size (Persons)   |           |            |      |
| 1–4                        | 128       | 53.3       |      |
| 5–8                        | 100       | 41.7       | 6    |
| 9–12                       | 12        | 5.0        |      |
| Farm Size(hectares)        |           |            |      |
| 1–5                        | 209       | 87.1       |      |
| 6–10                       | 28        | 11.7       |      |
| 11–15                      | 3         | 1.2        |      |
| Source of Fund for Cocoa Production | | | |
| Family                     | 44        | 18.3       |      |
| Friends                    | 6         | 2.5        |      |
| Bank Loans                 | 3         | 1.2        |      |
| Cooperatives               | 22        | 9.2        |      |
| Personal Savings           | 165       | 68.8       |      |

Source: Field Survey, 2019.

Table 1. Distribution of respondents according to their socio-economic characteristics (n = 240).
the Bank. This may be due to the inability to meet the Banks' requirements for collateral security.

4.2. Respondents' utilization of CRIN approved pesticides

4.2.1. Type of CRIN approved insecticides used

Table 2 shows the various insecticides approved for use by CRIN. The results reveal that the major insecticide approved and utilized by the majority of the farmers was Actara (83.3%). Actara 25 WG, which contains 25% Thiamethoxam as the major active ingredient, is a unique systemic insecticide that offers excellent, fast-acting, and long-lasting elimination of sucking and chewing pests, preventing damage to crops before it starts. Actara quickly penetrates the leaf surface and eliminates pests within 24 hours of application. Other approved insecticides used by few farmers in their cocoa farms were Esiom (11.7%) and Proteus (7.5%), which has the same active ingredient of Acetamiprid + Cypermethrin were used to control mirid pest, popularly referred to as ‘fari fari’ by the farmers.

Meanwhile, it was discovered that very few cocoa farmers were still using some pesticides, not on the list of recommended pesticides by CRIN. These insecticides include Supercare, Avestrin, Sharpshooter, Ironforce, Cyperforce, and Larafore. Insecticides such as Supercare, Avestrin, and Cyperforce contained Cypermethrin as its active ingredient as the CRIN approved insecticides, while Sharpshooter and Ironforce's major active ingredient is Profenfos. Larafore's active ingredient is Lambda-Cyhalothrin. During the interview schedule with the farmers, they asserted that they used these pesticides because of their activeness. The results support the findings of Akinneye et al. (2018) in the study carried out in Ondo State on pesticide residue in cocoa beans, which shows that the active ingredients found in some sampled cocoa were Cypermethrin, Profenfos, and Lambda-Cyhalothrin.

4.2.1.1. Frequency of usage of CRIN approved insecticides

Figure 2 shows that 35.8% of the respondents had used Actara three times, 21.7% used Actara twice, and 17.9% used it more than four (4) times, while only 7.9% used it once in a season. While Figure 3 shows, the error bar of the usage of CRIN approved insecticides. The recommended frequency of usage by the experts is 1–3 times/season. This indicates that most respondents complied with the recommended frequency of usage. Only very few of the farmers did not comply with the frequency of usage. Those who did not follow the recommended frequency attributed it to the frequency of rainfall in the season which caused them to re-spray sometimes, and some believe they must spray their farm at least once in a month during the raining season as a precaution measures against pest attacks, while others are just in the habits of spraying every 2 weeks from June to October.

The results also further revealed that some of the Cocoa farmers were still in the habit of using fungicides, Ultimax Plus, and Ridomil Gold more than the recommended frequency of usage by experts (1–3 times/season) depending on the prevalence of the pests and if their farm is properly pruned. Their reasons range from frequent attacks of the pest (black pod) on their cocoa plantation to the frequency of rainfall in the season which cause them to re-spray sometimes, and some believe they must spray their farm at least once in a month during the raining season as a precaution against pest attacks, while others are just in the habits of spraying every 2 weeks from June to October.

4.2.2. Type and frequency of utilization of CRIN approved fungicides

The types and frequency of utilization of approved fungicides used by the respondents were presented in Table 3. The results reveal that 69.2% of the cocoa farmers used Ridomil Gold, 65.8% of the cocoa farmers used Ultimax Plus, and 53.3% of the cocoa farmers used Red Force in their cocoa farms. The frequency of usage of these pesticides was as recommended. These fungicides contained Metalaxyl M + Copper Oxide as the major active ingredients and were very active in controlling black pod pests, which the farmers refer to as ‘kori kori’. Very few respondents used copper Nordox, Champ DP, and Funguran-OH.

The result further revealed that the majority of the cocoa farmers did not use Kocide 101, Kocide 2000, and Pergado, although the pesticides were among the recommended fungicides approved by CRIN. This could be due to lack of awareness of these fungicides. It was also discovered that some fungicides were used by few respondents which were not on the list of approved fungicides by CRIN. These include Mackecknie Gold, Blue bolt, and Ridoco, which contain the same active ingredient (Metalaxyl M + Copper Oxide) as approved fungicides. This could result from the availability of these fungicides in the study area and the cost. Meanwhile, the majority of the cocoa farmers followed CRIN's recommendations by using approved fungicides.

The results also further revealed that some of the Cocoa farmers were still in the habit of using fungicides, Ultimax Plus, and Ridomil Gold more than the recommended frequency of usage by experts (1–3 times/season) depending on the prevalence of the pests and if their farm is properly pruned. Their reasons range from frequent attacks of the pest (black pod) on their cocoa plantation to the frequency of rainfall in the season which cause them to re-spray sometimes, and some believe they must spray their farm at least once in a month during the raining season as a precaution against pest attacks, while others are just in the habits of spraying every 2 weeks from June to October.

The results aligned with the findings of Akinneye et al. (2018) in the study carried out in Ondo state, indicating that the fungicides used in cocoa farms were Red Force, Ridomil Gold, Mackecknie Gold, Red Bolt, and Ultimax Plus, which contain the same active ingredients of Metalaxyl-M and Copper (1) Oxide. The results also corroborate the findings of Issa (2016) that the high consumption of fungicides in Ondo State could not be unconnected with the prevalence of fungi attacks on cocoa.

4.2.3. Type and frequency of utilization of CRIN approved herbicides

The types and frequency of utilization of CRIN approved herbicides used by cocoa farmers were presented in Table 4, and the results show that the greater proportion of the cocoa farmers (44.2%, 22.5%, and 18.8%) used Clear Weed, Touch Down, and Round-Up, respectively. Other herbicides used by the very few (4.6%, 1.2%) respondents includes Everest and Paraquat, respectively. This implies that the respondents mostly used herbicides was Clear Weed, also known as Glyphosate. Although few respondents claimed they rarely used herbicides on their cocoa farms, as they pruned and cleared the weed with hoes and cutlasses. This result opposed the findings of Aminu et al. (2019) in the research carried out in Ondo State which stated that majority of the respondents used Glyphosate and Paraquat. The results is however supported by the findings of Issa (2016) which indicated that herbicides commonly used in Ondo State were Glyphosphate, Paraquat, and Atrazine.

4.2.4. Type and frequency of utilization of CRIN approved fumigants

The types and frequency of utilization of approved fumigants used by the respondents were presented in Table 5. The results show that very few (2.5%) respondents used Phostoxin, CRIN's only approved fumigant. This result implies that majority of the respondents did not use Phos- toxin in their cocoa farms. It was only used as a preservative when storing dried cocoa beans for a long period, most farmers do not store their cocoa beans beyond a season.

4.2.5. Compliance with safety precautions when using pesticides

Results in Table 6 show that all the respondents complied with the safety precautions when using pesticides. These precautions include using the right pesticides (100%), avoiding mixing herbicides with fungicides
using banned pesticides (100%), purchasing from reputable sources (100%), and does not engage child labour (100%).

Other safety precautions that the respondents complied with includes using the right dosage (99.6%), avoid eating, drinking, and smoking during spraying (99.2%), avoid leaving pesticides in spraying equipment overnight (98.3%), never store pesticides in living rooms, kitchens, animal houses or toilets (98.3%), proper disposal of empty pesticides containers (97.9%), proper calibration of sprayer (97.5%), wearing of personal protective equipment (97.5%), using the right spraying equipment (96.7%), washing contaminated or work clothes separately (95.0%), applying pesticides at the right time (93.8%), reading labeling instruction (90.0%), adhering to instructions (89.6%), and avoid entering sprayed farm until 24 hrs after spraying (84.6%).

This indicates that most of the respondents fully complied with pesticides safety precautions. This may be connected to the fact that most respondents were well-educated and understood label directions and instructional manuals of chemicals. The results corroborate the findings of Kemabonta et al. (2014), which state that most farmers were in full compliance with safety practices when applying pesticides on their farmlands.

Table 3. Type and frequency of utilization of CRIN approved fungicides.

| Fungicides         | Used Frequency of Usage | Not Used Frequency of Usage |
|--------------------|-------------------------|----------------------------|
|                    | Once  | Twice | Thrice | Four times and above |
| Approved           |       |       |        |                      |
| Ridomil Gold 66WP  | 166 (69.2) | 74 (30.8) | 6 (2.5) | 6 (2.5) | 52 (21.7) | 102 (42.5) |
| Ultimax Plus       | 158 (65.8) | 82 (34.2) | 2 (0.8) | 9 (3.8) | 2 (0.8) | 4 (1.7) | 3 (1.2) | 104 (43.3) |
| Funguran-OH        | 9 (3.8) | 231 (96.2) | - | 2 (0.8) | 4 (1.7) | 3 (1.2) | 5 (2.1) |
| Copper Nordox      | 14 (5.8) | 226 (94.2) | - | 2 (0.8) | 7 (2.9) | 7 (2.9) | 5 (2.1) |
| Champ DP           | 14 (5.8) | 226 (94.2) | 1 (0.4) | 1 (0.4) | 7 (2.9) | 5 (2.1) |
| Kocide 101         | - | 240 (100) | - | - | - | - | - |
| Kocide 2000        | - | 240 (100) | - | - | - | - | - |
| Cabrrio Duo        | 1 (0.4) | 239 (99.6) | 1 (0.4) | - | - | - | - |
| Red Force          | 128 (53.3) | 112 (46.7) | 1 (0.4) | 2 (0.8) | 35 (14.6) | 90 (37.5) |
| Pergado            | - | 240 (100) | - | - | - | - | - |
| Others             |       |       |        |                      |
| Mackecknie Gold    | 23 (9.6) | 217 (90.4) | - | 2 (0.8) | 8 (3.3) | 13 (5.4) |
| Ridocom            | 4 (1.7) | 236 (98.3) | - | - | - | 4 (1.7) |
| Blue Bolt          | 10 (4.2) | 230 (95.8) | - | 1 (0.4) | 4 (1.7) | 5 (2.1) |

Multiple responses.
Figures in parenthesis are percentages.
Source: Field Survey, 2019.
4.2.6. Constraints faced by cocoa farmers in using the approved pesticides

The major constraints faced by cocoa farmers in using the approved pesticides, as indicated in Table 7, were lack of government support relating to grants and subsidizing inputs (X = 2.97), poor access to loans/credit facilities (X = 2.95), high cost of approved pesticides (X = 2.90), fluctuations in the price of agrochemicals (X = 2.65), and high cost of spraying equipment (X = 2.63). These constraints top the list as nearly all respondents indicated that the government does not support them in providing grants and loans, subsidizing the price of inputs such as spraying pumps, approved pesticides, and regularizing the price of these approved pesticides. Poor access to pesticide-related information (X = 2.10) and poor access to extension services (X = 2.00) were also ranked as major constraints as some cocoa farmers claimed that the extension agents were no longer visiting them in their communities.

Unpredictable weather conditions (X = 1.95), toxicity (poisonous nature of chemicals affecting farmers’ health while spraying) (X = 1.93), not comfortable with using protective wears while spraying (X = 1.88), spare parts of sprayer not available/affordable (X = 1.75), high cost of pesticide protective equipment/kit (X = 1.74), unavailability of pesticide protective equipment in local markets and stores (X = 1.60), unregulated importation of expired/banned pesticides (X = 1.58), difficulty in understanding label directions (X = 1.54), the problem of pest resistance due failure/ineffectiveness of pesticides (X = 1.41), unavailability of approved pesticides (X = 1.40), and high breakdown rate/short lifespan of spraying equipment (X = 1.31) were regarded as minor constraints as the mean score for the constraint is (X ≥ 2.0).

The results imply that lack of government support in terms of grants and inputs, lack of access to loans/credit facilities, high cost of approved pesticides, fluctuations in the price of agrochemicals, high cost of spraying equipment (spraying pump), poor access to pesticides related information, and poor access to extension services were the major constraint faced by cocoa farmers in the study area. The results support Adeogun and Agbongiarhuoyi’s (2009) findings, which state that the identified constraints with pesticides include the high cost of agrochemicals, inadequate government support, weak extension linkages, the problem of adulterated pesticides, and low access to government inputs. The results also aligned with the findings of Aminu et al. (2019).

5. Hypothesis testing

5.1. Association between selected socio-economic characteristics of cocoa farmers and their compliance with safety precautions in using approved pesticides

H₀, which stated that there is no significant association between selected socio-economic characteristics of cocoa farmers and their compliance with safety precautions in utilizing approved pesticides, was tested using Chi-Square and the result in Table 8 revealed that educational status (X² = 6.087, p ≤ 0.05) had a significant association with

Table 4. Type and frequency of utilization of CRIN approved herbicides.

| Herbicides     | Used       | Not Used   | Frequency of Usage |
|---------------|------------|------------|--------------------|
|               | Once       | Twice      | Thrice             |
| Approved      |            |            |                    |
| Touch Down    | 54 (22.5)  | 186 (77.5) | 8 (3.3)            |
| Clear Weed    | 106 (44.2) | 134 (55.8) | 6 (2.5)            |
| Round Up      | 45 (18.8)  | 195 (81.2) | 2 (0.8)            |
| Others        |            |            |                    |
| Everest       | 11 (4.6)   | 229 (95.4) | -                  |
| Paraquat      | 3 (1.2)    | 237 (98.8) | 1 (0.4)            |

Multiple Responses.
Figures in parenthesis are percentages.
Source: Field Survey, 2019.

Table 5. Type and frequency of utilization of CRIN approved fumigants.

| Fumigants   | Used       | Not Used   | Frequency of Usage |
|-------------|------------|------------|--------------------|
|             | Once       | Twice      | Thrice             |Four times and above|
| Approved    |            |            |                    |
| Phostoxin   | 6 (2.5)    | 234 (97.5) | 6 (2.5)            | -                  |

Multiple Responses.
Figures in parenthesis are percentages.
Source: Field Survey, 2019.

Table 6. Distribution of respondents according to compliance with safety precautions when applying pesticides.

| Compliance with Safety Precautions | Frequency | Percentage |
|-----------------------------------|-----------|------------|
| Reading labelling instructions    | 216       | 90.0       |
| Adhering to instructions          | 215       | 89.6       |
| Wearing of personal protective equipment | 234 | 97.5 |
| Avoid eating, drinking, and smoking during spraying | 238 | 99.2 |
| Washing contaminated or work clothes separately | 228 | 95.0 |
| Using the right pesticides        | 240       | 100.0      |
| Avoid mixing herbicide with fungicide | 240 | 100.0 |
| Using the right dosage            | 239       | 99.6       |
| Avoid spraying against the wind direction | 240 | 100.0 |
| Applying the pesticides at the right time (before the pre-harvest interval, e.g. 1 month) | 225 | 93.8 |
| Using the right spraying equipment | 232       | 96.7       |
| Proper calibration of sprayer (use the right amount of water (volume rate) and pesticides mixture) | 234 | 97.5 |
| Regular repair and maintenance of spraying equipment | 240 | 100.0 |
| Proper disposal of empty pesticides container | 235 | 97.9 |
| Proper handling and storage of pesticides | 240 | 100.0 |
| Avoid expired pesticides          | 240       | 100.0      |
| Avoid leaving pesticides in spraying equipment overnight (mixing pesticides to use for the day only) | 236 | 98.3 |
| Avoid using banned pesticides     | 240       | 100.0      |
| Purchasing pesticides from reputable sources | 240 | 100.0 |
| Avoid entering sprayed farm 24 h after spraying | 203 | 84.6 |
| Never store pesticides in living rooms, kitchens, animal houses, or toilets. | 236 | 98.3 |
| Does not engage in child labour    | 240       | 100.0      |

Multiple Responses.
Source: Field Survey, 2019.
compliance. This implies that learned farmers understand and complied with safety precautions while using pesticides more than their counterparts who are not learned. Sex, marital status, and fund source had no significant association with compliance with safety precautions in using approved pesticides.

Education significantly affects farmers’ decisions to adopt safety measures (Muhammad et al., 2013). Respondents with a higher level of formal education had significantly more knowledge and acceptable pesticides usage (Sam et al. 2008). Therefore, the null hypothesis was accepted for Sex, Marital Status, and Source of Fund but rejected for Educational Status.

6. Conclusions and recommendations

The majority of the cocoa farmers followed and utilized the CRIN approved and recommended insecticides, pesticides, and fungicides in their cocoa farms, and they followed the recommended frequency of usage. However, only very few cocoa farmers were still in the habit of spraying their cocoa farms more than three (3) times in a season which is against the recommended frequency of usage. The result also revealed that the majority of the cocoa farmers in the study area complied with pesticide safety measures. This could be attributed to their literacy level because there was a significant association between education level and compliance with safety precautions in using approved pesticides.

The major constraints faced by cocoa farmers in using the approved pesticides were lack of government support in terms of grants and provision of inputs, lack of access to loans/credit facilities, high cost of approved pesticides, and poor access to pesticides related information. The study recommends that cocoa farmers should be assisted with timely provision of approved cocoa pesticides by government, non-governmental agencies and private organizations.

Declarations

Author contribution statement

Adeola Adetutu Adejori: Conceived and designed the experiment; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Oluwole Matthew Akinnagbe: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest’s statement

The authors declare no conflict of interest.

Additional information

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