ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25oct405

Sociodemographic Characteristics of Pesticide Users, Types of Pesticides, and Pesticide Application Practices Among Farmers in Lake Alau and Gongolong Irrigation Sites, Maiduguri, Borno State, Nigeria

Mohammed Isa Tada[1*]; Muhammad Waziri[2]; Musa Ali Muhammad[3]; Usman Ngamarju Gadzama[4]; Musa Adamu Ibrahim[5]

[1]Department of Biology, Faculty of Life Sciences, University of Maiduguri, Maiduguri, Nigeria

[2]Federal College of Freshwater Fisheries Technology, Baga, Borno State, Nigeria

[3]Department of Zoology, Faculty of Life Sciences, University of Maiduguri, Borno State, Nigeria

[4]Department of Zoology, Faculty of Life Sciences, University of Maiduguri, Maiduguri, Nigeria

[5]Department of Biology, Faculty of Life Sciences, University of Maiduguri, Maiduguri Nigeria

Corresponding Author: Mohammed Isa Tada[1*]

Publication Date: 2025/10/13

Abstract: The unregulated use of pesticides in wetland agriculture poses significant environmental and health risks worldwide. Farmers' limited knowledge and unsafe handling practices exacerbate exposure hazards. This study aims to investigate the socio-demographic characteristics of pesticide users and identify/classify the types of pesticides used by farmers in Lake Alau and Gongolong irrigation sites. A two-part questionnaire was used to collect data on the socio-demographics of 390 (farmers) pesticide users and pesticide usage patterns in the Alau and Gongolong areas. Descriptive statistical measures, such as frequency and percent, were used to describe and interpret the data. SPSS software version 24 was used for data analysis. The respondents' demographics showed that most were 23-32 years old. In terms of education, 52.8% had Sangaya education, 33.3% had SSCE, and 13.9% had a Diploma. Insecticides were the most commonly used pesticide, with neonicotinoids dominant in Alau and organophosphates in Gongolong. Popular pesticide brands included Caterpillar Force, Forceup, and Z-force. Solvent-based pesticides were widely used, and most farmers applied pesticides during the fruiting stage, taking safety measures like considering wind direction. Spraying was the primary application method in both locations. Pesticide use in Alau and Gongolong, Nigeria, poses risks to the environment, health, and agricultural sustainability due to farmers' limited knowledge and excessive use of hazardous chemicals. A comprehensive approach is needed to promote safe and sustainable pesticide use practices, including awareness creation, regulation, incentives for eco-friendly practices, and the provision of personal protective equipment.

How to Cite: Mohammed Isa Tada; Muhammad Waziri; Musa Ali Muhammad; Usman Ngamarju Gadzama; Musa Adamu Ibrahim (2025). Sociodemographic Characteristics of Pesticide Users, Types of Pesticides, and Pesticide Application Practices Among Farmers in Lake Alau and Gongolong Irrigation Sites, Maiduguri, Borno State, Nigeria. *International Journal of Innovative Science and Research Technology*,10(10), 567-582. https://doi.org/10.38124/ijisrt/25oct405

I. INTRODUCTION

The unregulated use of pesticides in wetland agriculture poses significant environmental and health risks worldwide. Farmers' limited knowledge and unsafe handling practices exacerbate exposure hazards (Adesuyi *et al*., 2018). Pests, diseases, and plant pathogens threaten crop yields, prompting widespread pesticide use. Driven by global population

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25oct405

growth and food security needs, pesticide application has surged, reaching around 3 billion kilograms annually (Farag *et al,* 2011; Tudi *et al*., 2021) to meet the rising demand for food and agricultural products. Population growth is one of the major factors that necessitate more agricultural activities to provide food and other materials, which leads to the high application of pesticides to boost production and control pests (Quandahor *et al*., 2024). Pesticides help farmers boost crop yields and protect against pests and diseases. However, their improper use can have severe consequences. By controlling pests and weeds, pesticides play a crucial role in agriculture (FAO, 2022). The global pesticides trade has significantly increased to $41.1 billion in 2020 (FAO, 2022). Developing countries are driving up pesticide demand, now accounting for a quarter of global usage (EU, 2021). But the death rates because of pesticide poisoning are quite high in the developing countries (Sharma *et al.*, 2019). Educating and training farmers on safe pesticide use can minimize environmental and food contamination risks (Mubushar *et al*., 2019). Poverty and illiteracy in developing countries, including Nigeria, worsen pesticide safety concerns in farming communities (Tolera, 2020). Farmers' negative attitudes and limited access to information and education hinder the adoption of pesticide safety precautions (Sapbamrer and Thammachai, 2020). Research in countries such as Ethiopia and Iran has linked improper pesticide use to farmers' limited knowledge and unfavorable attitudes toward safe handling practices (Rezaei *et al*., 2018). Other studies have found a strong correlation between farmers' knowledge, attitude, and perception regarding pesticide use (Mohanty *et al.,* 2013). A higher proportion of pesticide poisonings and deaths occur in developing countries where there are inadequate occupational safety standards, a lack of use of personal protective equipment (PPE), inadequate hygienic facilities, illiteracy, and insufficient knowledge of pesticide hazards (Mejia *et al*., 2014; Macharia *et al*., 2013). Furthermore, without sufficient ventilation and adequate PPE, pesticide fumes may be inhaled and dermally absorbed into the human body (Ncube *et al*., 2011). Pesticide exposure can cause health problems such as human carcinogens, dermatitis, kidney disorders, endocrine disruption, reproductive effects, blurred vision, neuropsychiatric disturbance, and memory loss (Macharia *et al*., 2013).

II. MATERIALS AND METHODS

➢ *Study Area*

Alau Dam is located in Konduga LGA, Borno State, North-eastern Nigeria. The Dam is 9 m high with a square reservoir area of about 50 km^2, with a maximum storage capacity of 112 Mm^3. Alau Dam receives water from the river Yedzram and the river Gombole, which merge at a confluence in Sambisa before flowing into the river Ngadda, which feeds Alau Dam. It was constructed in 1987 on the river Nggada to supply potable drinking water to the Maiduguri metropolis with over 8000 hectares of farmland in the catchment area of the Lake Chad Basin Development Authority (CBDA, 1984). It lies at a latitude of 11º41N and a longitude of 13º16E in the southeast (SE) part of Maiduguri town at 16 km from Maiduguri. The lake has a surface area of 56,000.00 hectares, a total water storage capacity of 9.50 million cubic meters, active storage capacity of 1.12×10^8 m^3. The height of the lake is about 540 meters, with crest length and crest elevation of 31.0 m and 331.50 m, respectively (CBDA, 1987; Mshelia *et al*., 2015).

ISSN No: -2456-2165

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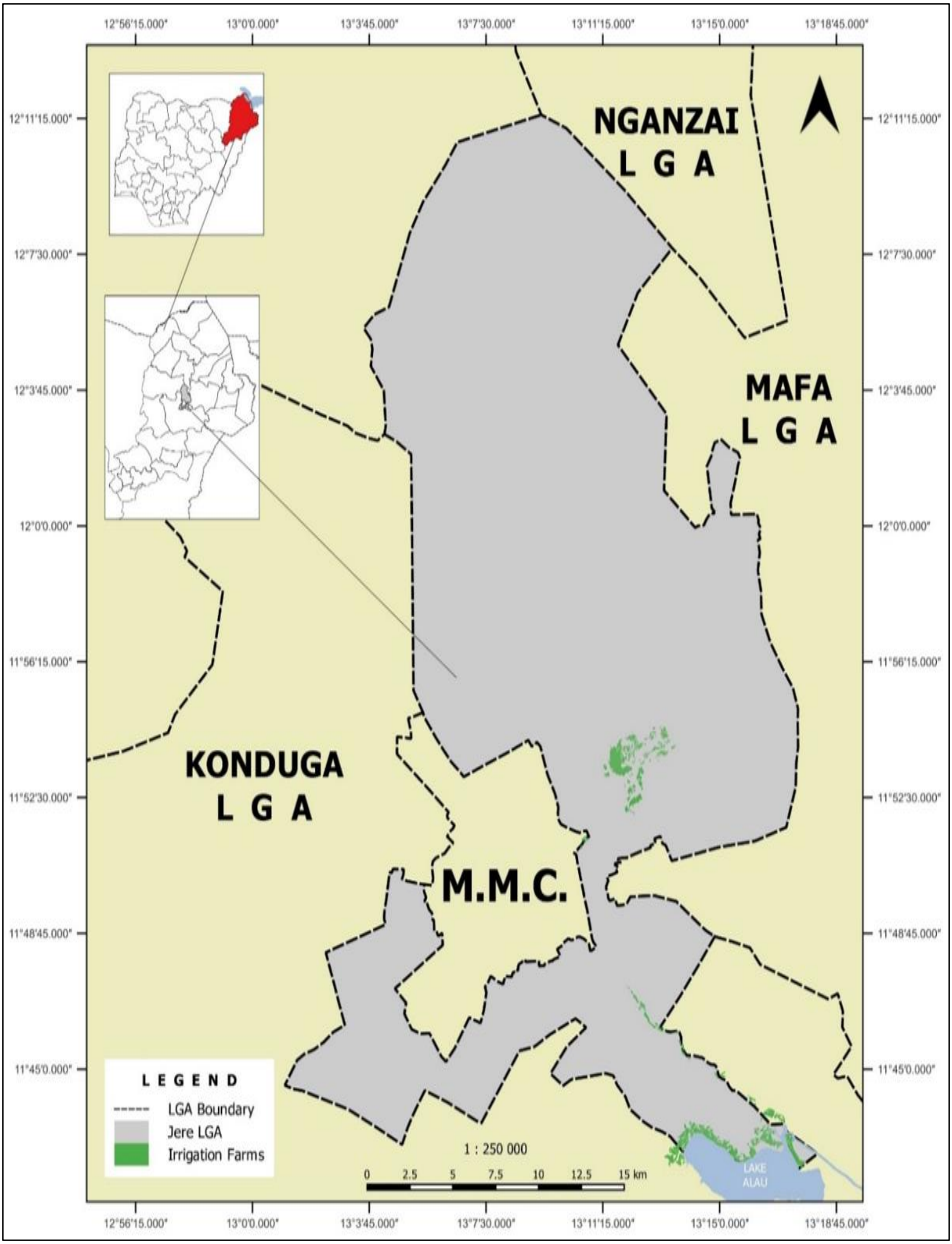

Fig 1 Jere Local Government Area Showing Irrigation Farms.
Source: Department of Urban and Regional Planning, Faculty of Environmental Studies, University of Maiduguri (2023).

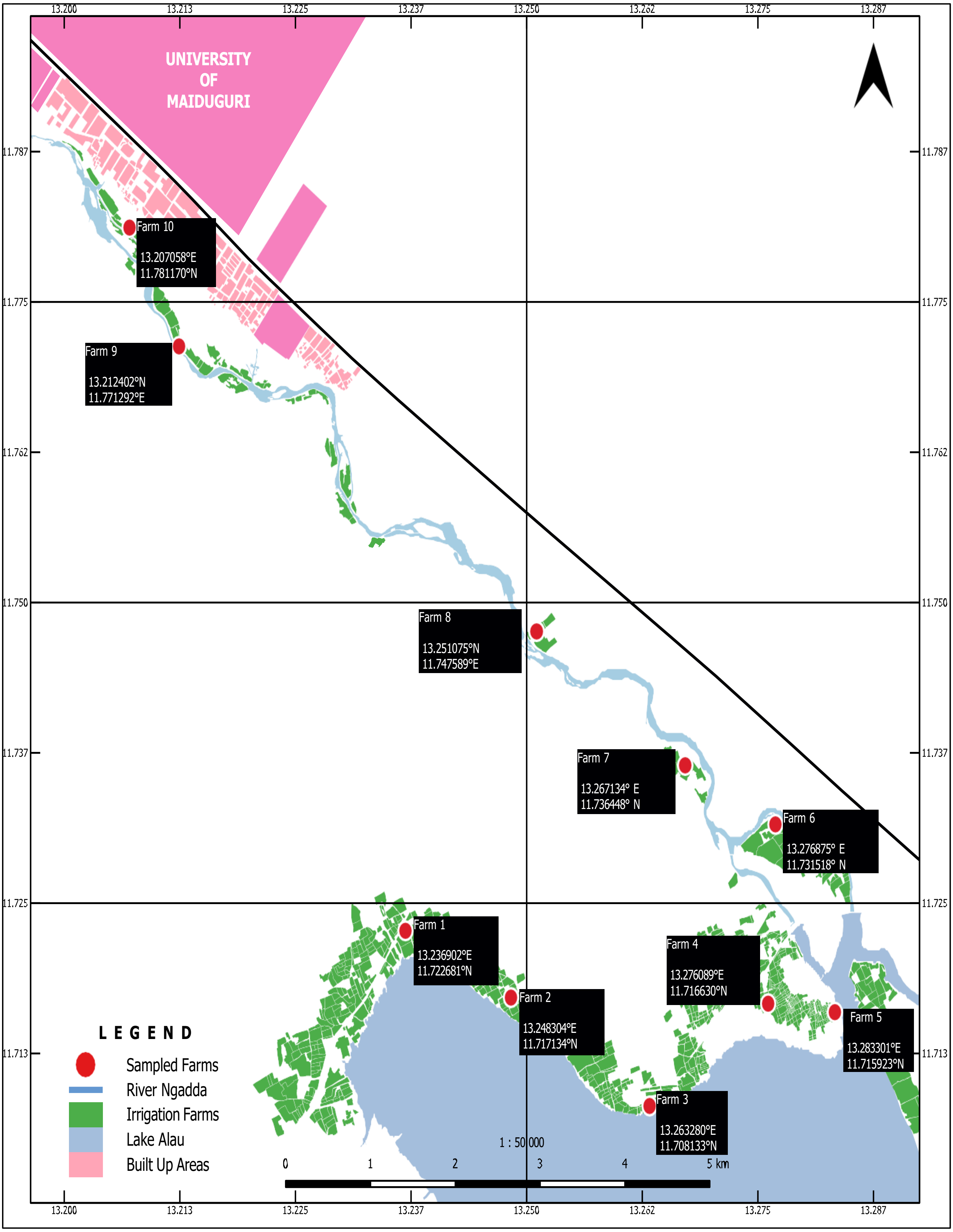

Fig 2 Alau Irrigation Farms.
Source: Department of Urban and Regional Planning Studio, Faculty of Environmental Studies, University of Maiduguri (2023).

International Journal of Innovative Science and Research Technology
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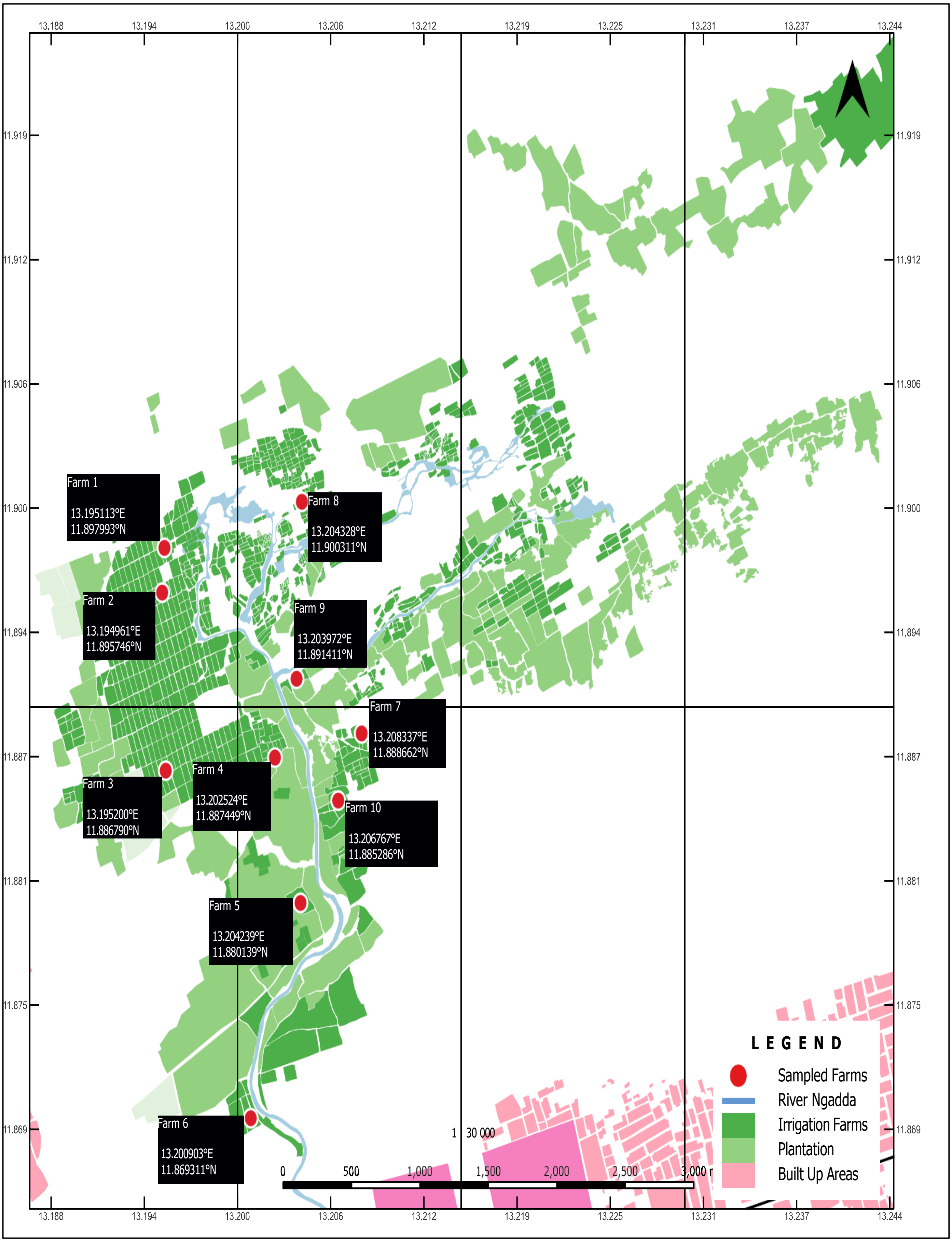

Fig 3 Gongulong Irrigation Farm s.
Source: Department of Urban and Regional Planning Studio, Faculty of Environmental Studies, University of Maiduguri (2023).

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➢ *Sample Size Determination and Procedure*

The sample size was determined using a single population proportion formula. The minimum sample size (n) for the study was calculated as follows. The formula used to calculate the minimum sample size (n) is n = $(Z\alpha/2)^2 * P * (1-P)/d^2$, where Zα/2 is the critical value (1.96 for 95% confidence), P is the estimated proportion (0.559 based on a previous study), and d is the desired margin of error (0.05) (Gesesew *et al*., 2016).

n = Sample size: The number of individuals or observations needed for the study.

Zα/2 = Critical value: For a 95% confidence interval, the Z-score is 1.96.

P = Estimated proportion: The proportion of the population expected to exhibit the characteristic of interest. In this case, it's 55.9% or 0.559.

d = Margin of error (precision): The acceptable level of error in the results, set at 0.05 (5%) in this case.

$n = (Z\alpha/2)^2 * P * (1-P) / d^2$,

$= (1.96)^2 * 0.559 * (1-0.559)/ (0.05)^2$

=379

However, the number was scaled up to three hundred ninety for convenience (that is, 379 + 11 = 390)

➢ *Data Collection on the Socio-Demographics of the Pesticide Users and Information on the Pesticides Used in Alau and Gongolong Areas (Questionnaire)*

A two-part questionnaire, adapted from Nguetti *et al.* (2018), was used to collect data from 390 farmers in Alau and Gongolong areas. A two-part questionnaire was used to collect data on the socio-demographics of pesticide users and pesticide usage patterns in Alau and Gongolong areas. The first part captured socio-demographic information, including age, gender, and education status of farmers. The second part gathered details on pesticide types, classes, commercial names, formulation forms, application timing, safety measures, and application methods. This structured approach, adapted from Nguetti *et al.* (2018), enabled comprehensive data collection for analyzing pesticide use practices among farmers.

➢ *Data Collection*

Data collection involved face-to-face interviews with 195 farmers from Alau and 195 from Gongolong, using a structured schedule. The data were then coded and analyzed (Nguetti *et al*., 2018).

➢ *Data Analysis*

Descriptive statistical measures, such as frequency and percent, were used to describe and interpret the data. The Statistical Product and Service Solutions (SPSS) software was used for data analysis.

III. RESULTS

➢ *The Age Group of the Respondents in the Alau and Gongolong Areas.*

Figure 4 reveals that most respondents in both locations are between 23-32 years old. In Gongolong, 16.7% of respondents were 23-27, while 13.9% were 28-32. Similarly, in Alau, 22.2% of respondents were 23-27 years old, and 13.9% were between this age bracket, 28-32. Comparing the two locations, we can see that Alau had a slightly higher percentage of respondents in the 23-27 age group. On the other hand, Gongolong had a higher percentage of respondents in the 18-22 age group (5.6% vs 1.4% in Alau).

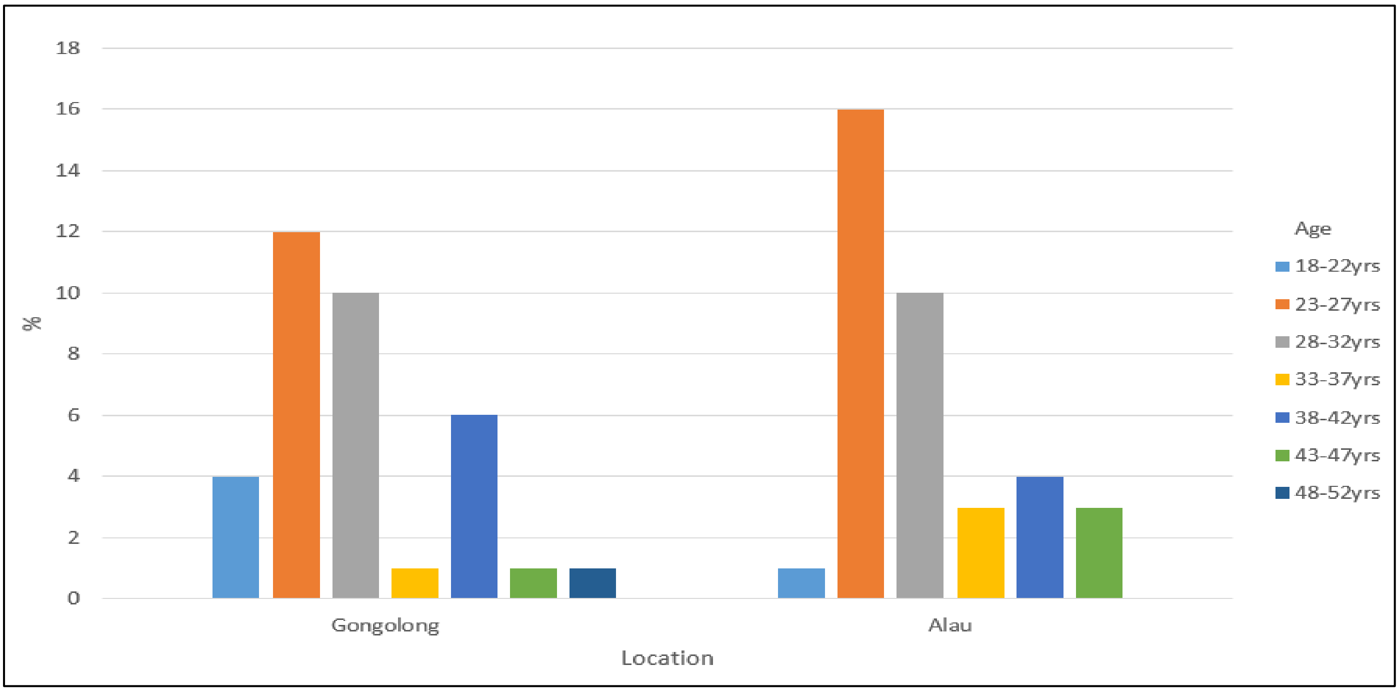

Fig 4 Age Group of Respondents in Alau and Gongolong

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➢ *Sex Distributions of the Respondents in Alau and Gongolong*

Figure 5 shows the sex distribution of respondents in Alau and Gongolong. All respondents in both locations were male, with no female respondents. The Gongolong area had 35 male respondents, making up 48.6% of the total respondents. Alau had 37 male respondents, accounting for 51.4% of the total respondents. The total of 72 male respondents represents 100% of the total respondents.

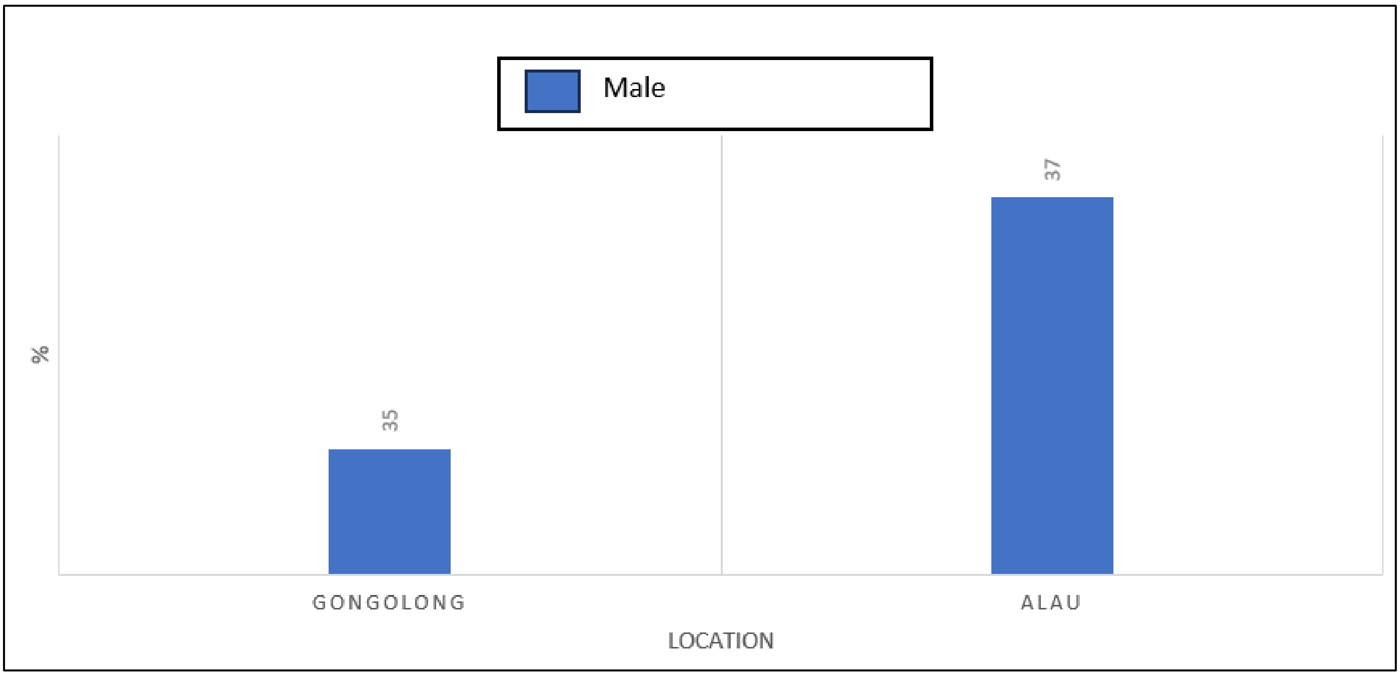

Fig 5 Sex of the Respondents in Alau and Gongolong

➢ *Educational Status of the Respondents in Alau and Gongolong*

Figure 6 reveals that most respondents have a Sangaya education (52.8%), followed by SSCE (33.3%) and Diploma (13.9%). The Gongolong area had a slightly higher percentage of respondents with Sangaya education (25.0%), while Alau had a slightly higher percentage of respondents with Diploma education (8.3%). Alau had a higher percentage of respondents with Sangaya education (27.8%) compared to Gongolong (25.0%). Conversely, Gongolong had a higher percentage of respondents with SSCE education (18.1%) compared to Alau (15.3%).

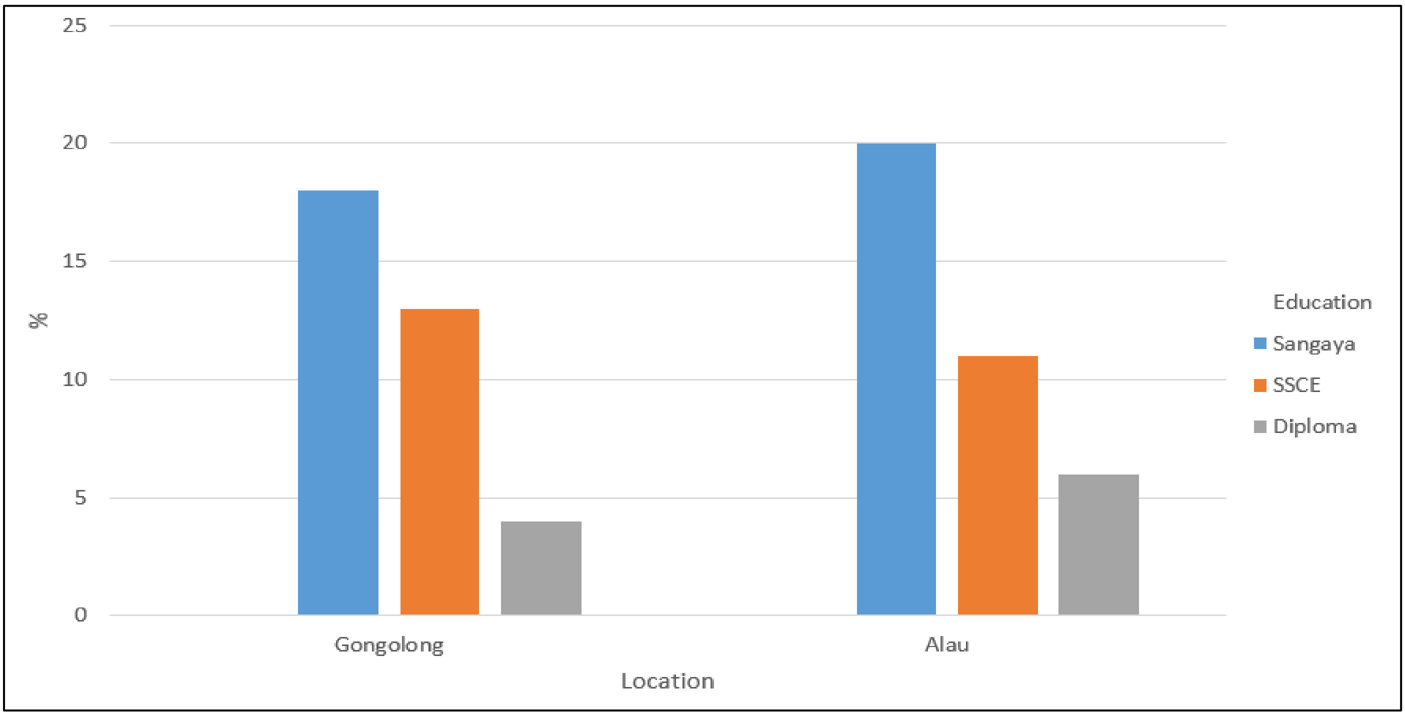

Fig 6 Educational Status of the Respondents in Alau and Gongolong

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- *Types of Pesticides Used by the Respondents in Alau and Gongolong*

Figure 7 reveals that insecticides were the predominant type of pesticide used in both Alau and Gongolong. A significant majority of respondents (70.8%) reported using insecticides. Alau had a higher percentage of respondents using insecticides (37.5%), while Gongolong had a higher percentage of respondents using herbicides (9.7%). Fungicide usage was relatively low in both locations, with Alau having a slightly higher rate (9.7%).

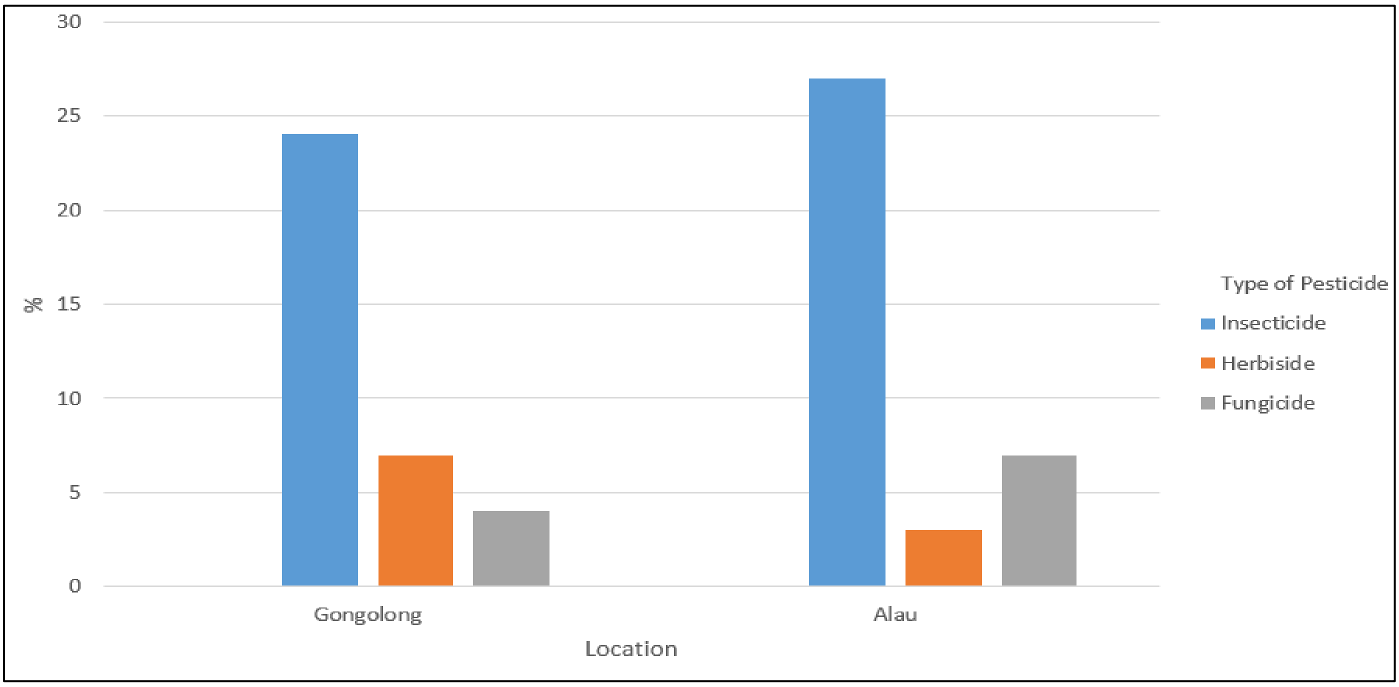

Fig 7 Types of Pesticides Used by the Respondents in Alau and Gongolong

- *Classes of Pesticides Used by the Respondents in Alau and Gongolong*

Figure 8 shows that respondents in both Alau and Gongolong used a variety of pesticide classes, including Organophosphate, Neonicotinoids, Pyrethroids, and Carbamate. Neonicotinoids were the most widely used class. Alau had a higher percentage of respondents using Neonicotinoids (18.1%), while Gongolong had a higher percentage of respondents using Organophosphates (15.3%). The diverse range of pesticide classes used by respondents suggests that pesticide usage patterns are complex and are prompted by various factors, such as crops, pests, and farming techniques.

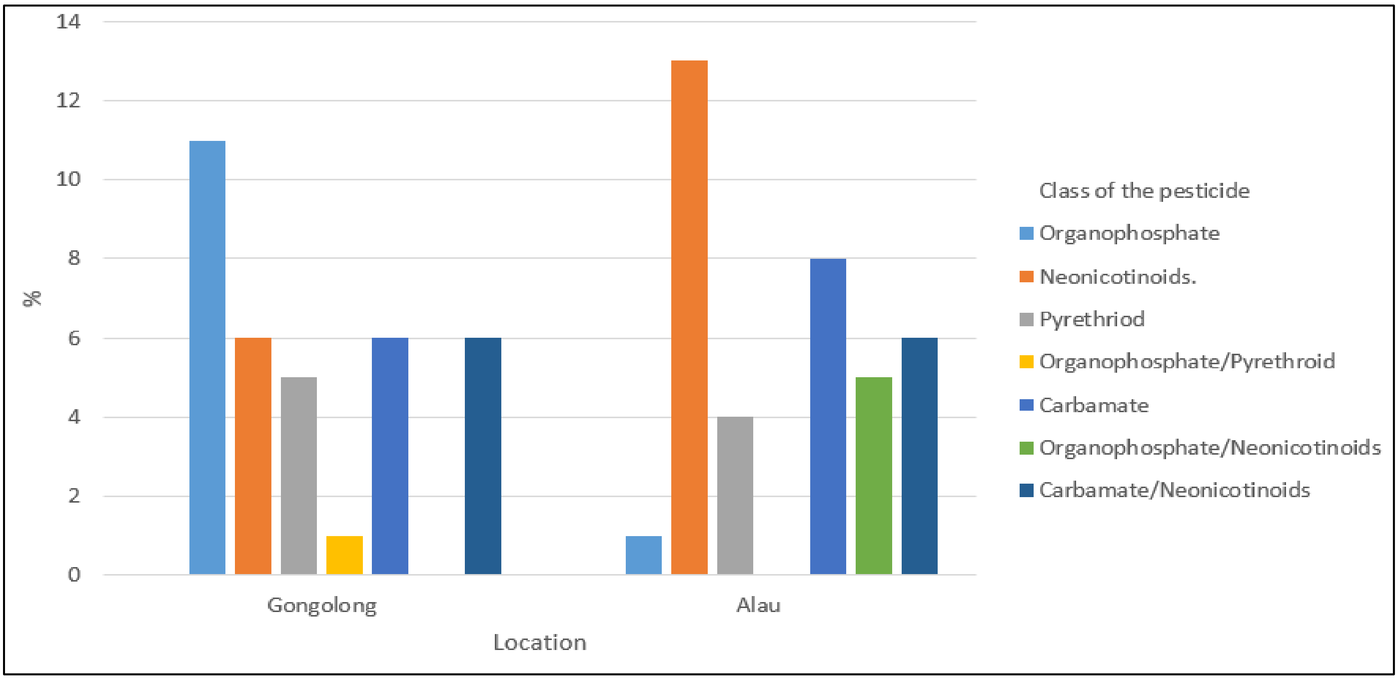

Fig 8 Classes of Pesticides Used by the Respondents in Alau and Gongolong

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➢ *Documented Pesticides Used by the Respondents by Their Trade or Commercial Name in Alau and Gongolong*

Figure 9 shows that respondents in both Alau and Gongolong used a wide variety of pesticides. Twenty different commercial names, such as Abamectin, Sharpshooter/Cypermethrin, and DD Force/Dichlorvos, were used exclusively in Alau, while others, like Caterpillar force/K-optimal, were used more often in Gongolong. Respondents in both locations used pesticides like Caterpillar force/K-optimal, force up/glyphosate/carbamate, and Z force/optimal.

The highest used pesticide in Alau was Caterpillar force/K-optimal (15.3% of the total respondents in Alau, which is 12.5% of the overall total). The lowest-used pesticides in Alau were Abamectin/Emacot and Caterpillar Force/Abamectin (1.4% of the total respondents in Alau). The most used pesticide in Gongolong was Force up/glyphosate/carbamate (11.1% of the total respondents in Gongolong, which is 8.3% of the overall total). The lowest-used pesticides were Abamectin and Agbectin (1.4% of the total respondents in Gongolong, which is 1.4% of the overall total).

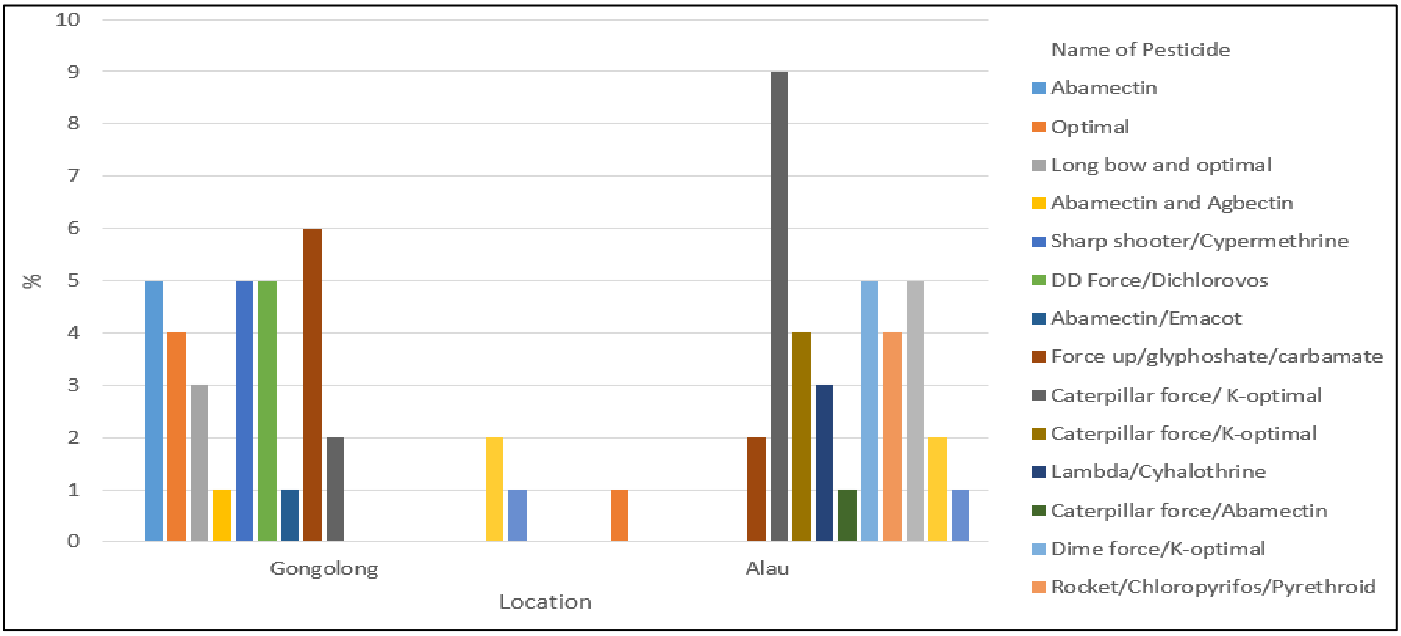

Fig 9 Documented Pesticides Used by the Respondents by Their Trade or Commercial Name in Alau and Gongolong

➢ *Pesticide Used by the Respondent Based on the Mode of Formulation in Alau and Gongolong*

Figure 10 indicates that solvent pesticides were the most used form in both Alau and Gongolong, with 48.6% and 40.3% of respondents, respectively. Liquid-based pesticides were also used, with 2.8% of respondents in Alau and 8.3% in Gongolong.

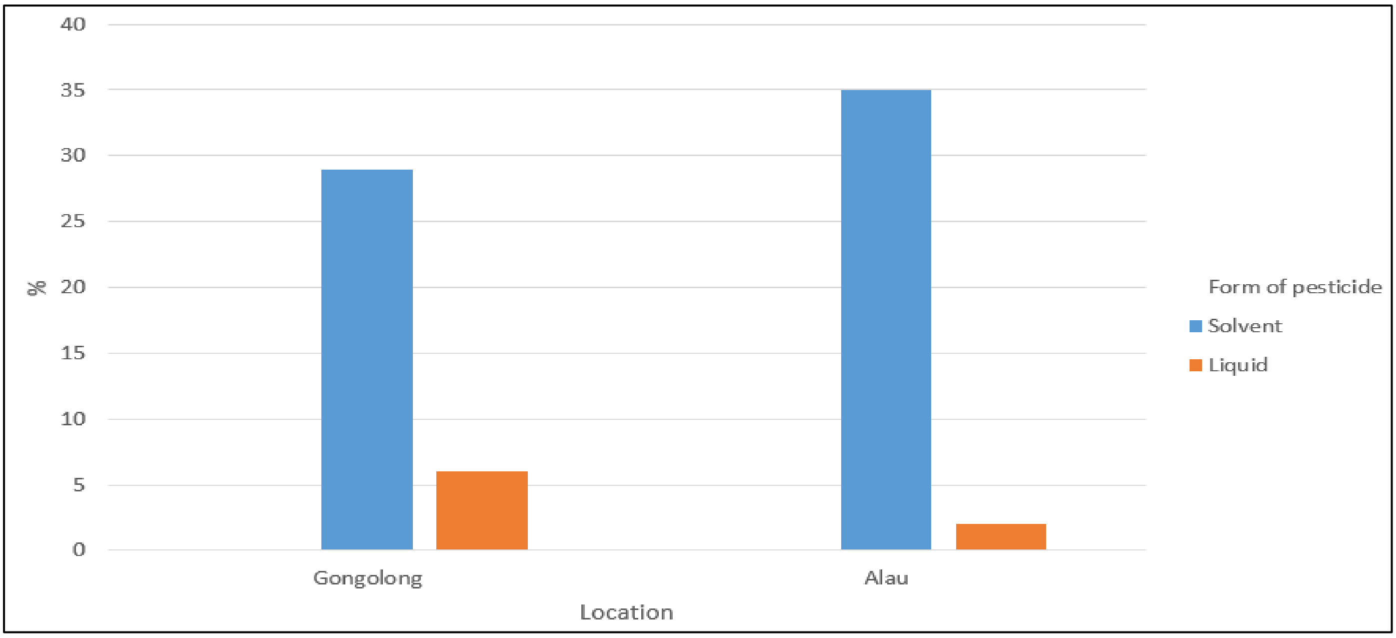

Fig 10 Pesticides Used by the Respondent Based on the Mode of Formulation in Alau and Gongolong

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➢ *Evaluation of the Time of Application of Pesticides Used by the Respondents in Alau and Gongolong*

Figure 11 reveals that most respondents in both Alau (31.9%) and Gongolong (19.4%) applied pesticides during the fruiting stage of crop development. Specifically, 18.1% of respondents in Gongolong and 15.3% in Alau applied pesticides during the flowering stage. The growing stage was the minimum time for pesticide application. Explicitly, 11.1% of respondents in Gongolong and 4.2% in Alau applied pesticides during the flowering stage.

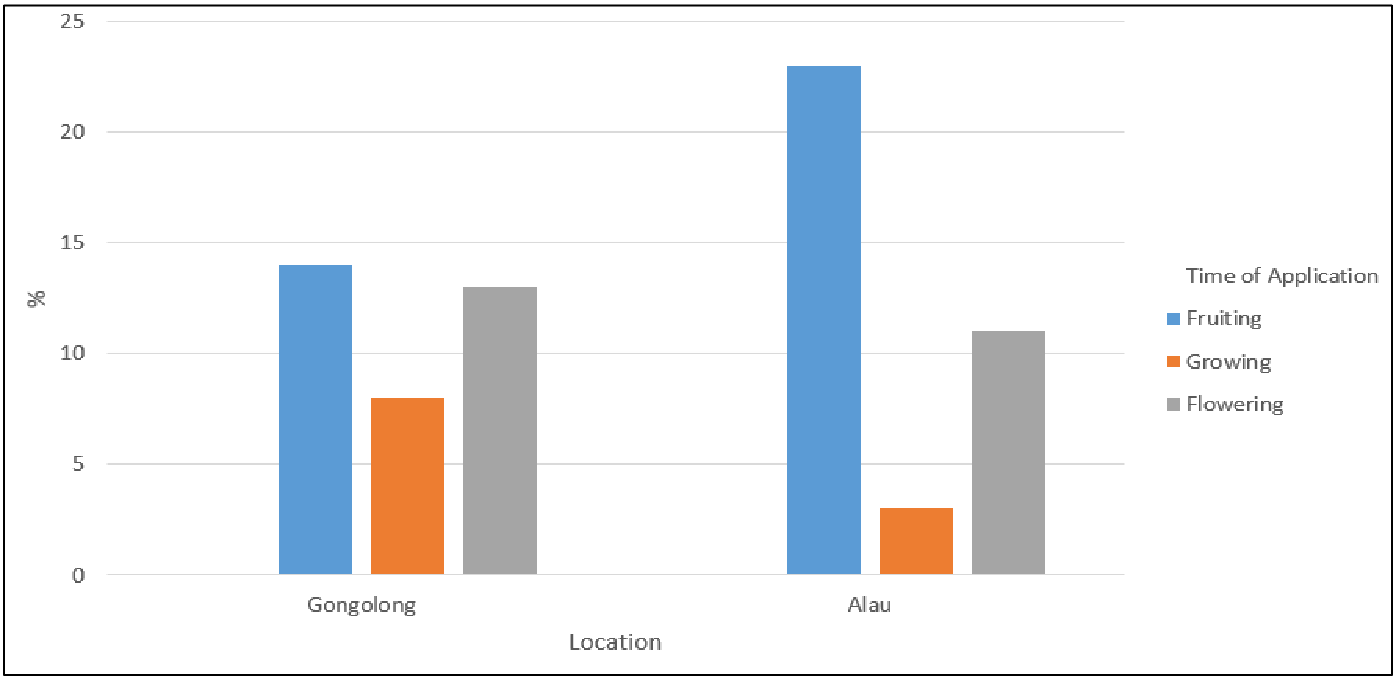

Fig 11 Evaluation of the Time of Application of Pesticides Used by the Respondents in Alau and Gongolong

➢ *Safety Measures Taken by Farmers During the Application of Pesticides in Alau and Gongolong*

Figure 12 reveals that most respondents in both Alau (29.2%) and Gongolong (26.4%) took wind direction into account when applying pesticides. Furthermore, the use of Personal Protective Equipment (PPE) was widespread, with many respondents in both locations (Gongolong 16.7% and Alau 11.1%) utilizing gloves, masks, and eye protection during pesticide applications. However, other essential safety measures (Gongolong 5.6% and Alau 11.1%), such as wearing protective clothing and washing hands after application, were employed by fewer respondents.

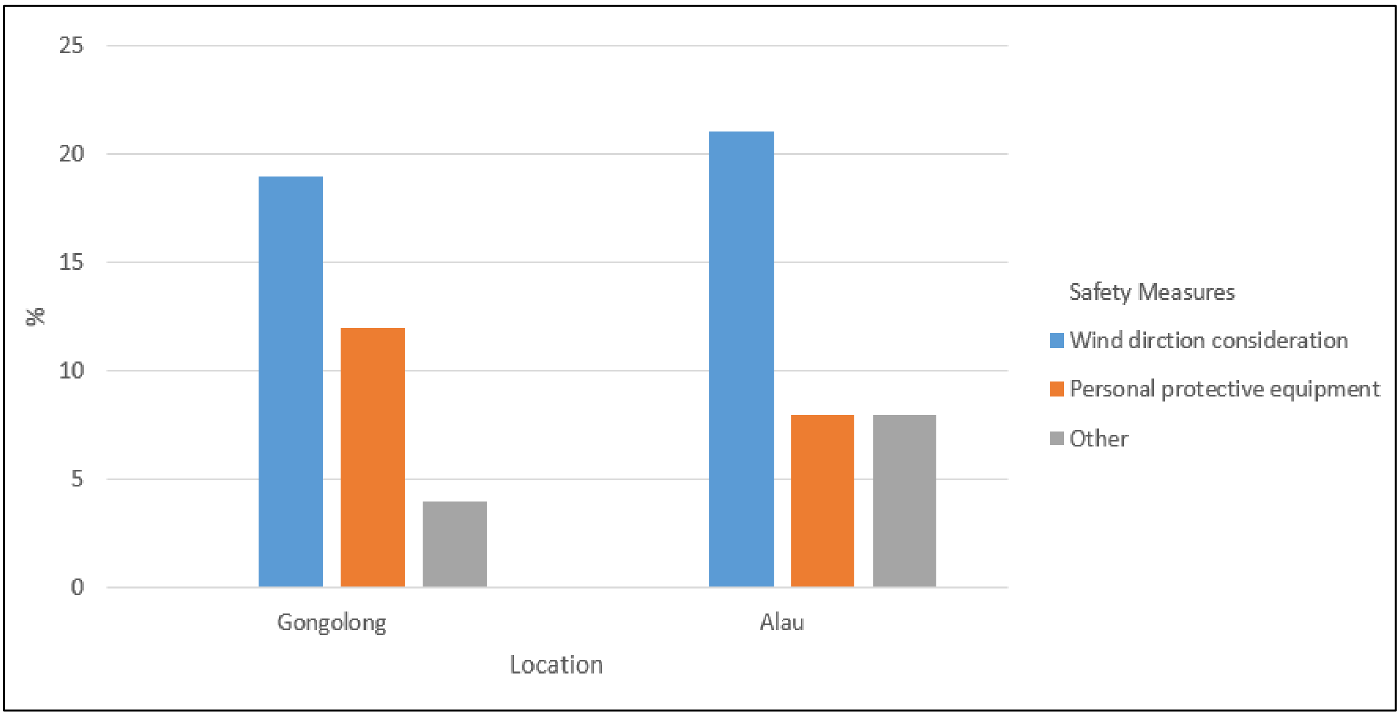

Fig 12 Safety Measures Taken by Farmers During the Application of Pesticides in Alau and Gongolong

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- *Assessment of the Application of Pesticide Methods Used by the Respondents in Alau and Gongolong*

Figure 13 indicates that spraying was the predominant pesticide application method in both Alau (51.4%) and Gongolong (48.6%). Notably, the data suggest that respondents in both locations entirely used spraying, with no reported use of alternative methods such as dusting or granule application.

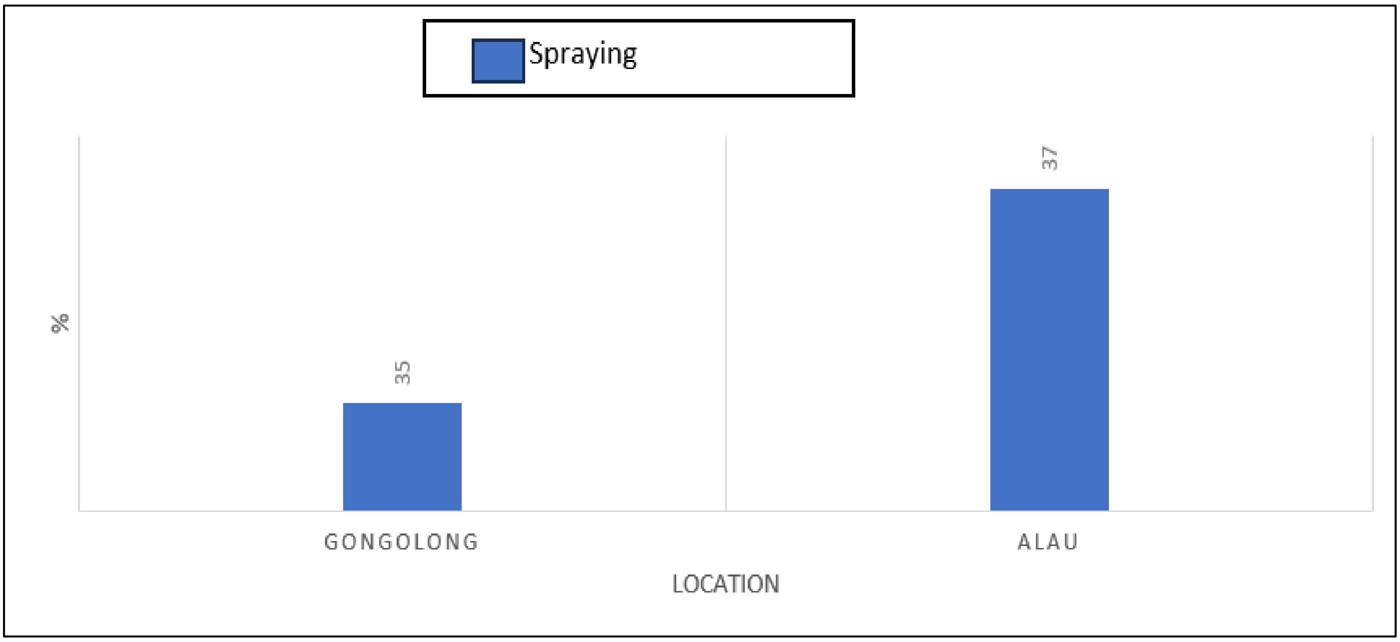

Fig 13 Assessment of the Application of Pesticide Methods Used by the Respondents in Alau and Gongolong

IV. DISCUSSION

- *Age Distribution of the Respondents in Relation to Pesticide Usage*

In the findings of Janmaimool & Watanabe (2014), the influence of socio-demographic factors (age, gender, education, socio-economic status, and membership in organizations), previous experiences, attitude, mental norm, and the perception of health risk was also influenced by the ability to control exposure. Generally, the findings suggest that the respondents in both Alau and Gongolong were predominantly young adults (between 23-32 years). In Gongolong, 16.7% of respondents were 23-27 years old, while 13.9% were 28-32 years old. Similarly, in Alau, 22.2% of respondents were 23-27 years old, and 13.9% were between this age bracket, 28-32. Comparing the two locations, we can see that Alau had a slightly higher percentage of respondents in the 23-27 age group. On the other hand, Gongolong had a higher percentage of respondents in the 18-22 age group (5.6% vs 1.4% in Alau). From this result, it can be deduced that people in the 23-27 age group made up the largest percentage (38.9%), followed by the 28-32 age group (27.8%) in handling pesticides.

The study is consistent with the research by Sumberg *et al*. (2012), who highlighted the importance of youth participation in agriculture, including their role in innovation, entrepreneurship, and rural development. Similarly, Sanginga *et al.* (2018) also found that youth-led agricultural initiatives in Africa have contributed to increased food security, improved livelihoods, and enhanced climate resilience. However, this finding disagrees with a study conducted by Mazur *et al.* (2017), which reported that older farmers tend to have more experience and knowledge about farming practices, while younger farmers are more likely to adopt new technologies and innovations.

- *Educational Status of the Respondents:*

Most of the respondents in Alau had Sangaya education (27.8%); however, 15.3% and 8.3% have SSCE and Diploma, respectively, which is slightly higher compared to the Gongolong area. The higher educational status in Alau could be attributed to its proximity to Dalori quarters and the University of Maiduguri, which gave the residents higher access to education compared to Gongolong. On the other hand, the low number of diplomas in Gongolong could be attributed to the distance between the area and other educational institutions within the city.

According to Yaghoti *et al.* (2021), the level of education predicts the average awareness of personal protective equipment. It's essential to consider demographic factors when promoting awareness about using personal protective equipment (PPE) while handling pesticides (Ahmadipour and Nakhei, 2024).

- *Sex of the Respondents*

All respondents in both locations were male, with no female respondents. The Gongolong area had 35 male respondents, making up 48.6% of the total respondents. Alau had 37 male respondents, accounting for 51.4% of the total respondents. The absence of female respondents could be due to the cultural context. Cultural and social norms in some regions of Borno State might limit women's involvement in certain activities, including farming. Another reason could be

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insecurity in the areas; it might limit their participation in agricultural activities.

The results are in line with the findings in India by Himani *et al.* (2015) and in Cameroon by Tarla *et al.* (2015), who reported less participation of women in agricultural activities and slightly contradicted the studies of Ayandiji and Omidiji (2011) in Nigeria, who did not find a great difference (51% males versus 49% females) among genders in their survey.

- *Types of Pesticides Used by the Respondents*

A significant majority of respondents (70.8%) reported using insecticides compared to other pesticides. Alau had a higher percentage of respondents using insecticides (37.5%), while Gongolong had a higher percentage of respondents using herbicides (9.7%). The dominance of insecticide usage could suggest that insect-related pests were a significant concern for farmers in both Alau and Gongolong. The changes in pesticide usage patterns between Alau and Gongolong may indicate regional differences in crop types, pest incidence, or farming methods. The widespread use of insecticides raises concerns about environmental and health impacts, such as water, soil pollution, and vegetable contamination.

Insecticides were commonly used pesticides because insect pests were more common in the study sites in the cultivation of vegetables. Similar results were found in a study in Tanzania (Yang *et al*., 2014), which reported massive use of insecticides. However, the study results were contrary to a study in Nigeria, where herbicides were commonly used to control pests (Satya Sai *et al.*, 2019).

- *Classes of Pesticides Used by the Respondents and Their Commercial Names*

Alau had a higher percentage of respondents using Neonicotinoids (18.1%), while Gongolong had a higher percentage of respondents using Organophosphates (15.3%). The diverse range of pesticide classes used by respondents could suggest that pesticide usage patterns are complex and prompted by various factors, such as crops, pests, and farming techniques. This finding agrees with Potts *et al.* (2010), who also found that the use of neonicotinoid pesticides has increased significantly in agriculture, particularly in the United States, Europe, and Asia. Goulson *et al.* (2015) highlighted the potential impacts of neonicotinoid pesticides on pollinators, such as bees, and ecosystems, including contamination of water and soil. The result also agrees with Ecobichon *et al.* (2013), who reported that organophosphate pesticides are extensively used in developing countries, particularly in Asia and Africa, due to their low cost and availability. Jors *et al*. (2018) highlighted the human health risks and environmental impacts associated with organophosphate pesticide use, including neurotoxicity, cancer, and contamination of water and soil.

The most used pesticides in Alau were Caterpillar force/K-optimal (12.5%). The lowest-used pesticides in Alau were Abamectin/Emacot and Caterpillar Force/Abamectin, Optimal, and Longbow. The most used pesticide in Gongolong was Forceup/glyphosate/carbamate (8.3%). The lowest-used pesticides were Abamectin and Agbectin (1.4%).

Caterpillar Force is a pesticide product that contains the active ingredient Chlorpyrifos. Chlorpyrifos is a broad-spectrum insecticide that controls a wide range of pests, including caterpillars, beetles, and aphids. Chlorpyrifos is particularly effective against lepidopteran pests, such as caterpillars, which are common pests in many crops (Christensen *et al*., 2009). However, it's essential to note that Chlorpyrifos has also been linked to several environmental and health concerns. (Christensen *et al*., 2009).

- *Form of Pesticides Used by the Respondents for Pest Control*

Solvent pesticides were the most used form in both Alau and Gongolong, with 48.6% and 40.3%, respectively. According to Wang & Liu (2007), liquid and solvent pesticides are often easier to apply than solid or granular formulations, as they can be mixed with water and sprayed directly on crops. This could be the reason behind the higher usage of solvent and liquid pesticides. Liquid pesticides can provide better coverage of plant surfaces, as they can spread and penetrate plant tissues more effectively. Liquid pesticides can be absorbed more quickly by plants, as they can be taken up through leaves or roots (Gerwick & Sparks, 2014).

- *Safety Measures Taken by the Respondents During Pesticide Applications.*

The respondents in both Alau (29.2%) and Gongolong (26.4%) took wind direction into account when applying pesticides. Furthermore, the use of Personal Protective Equipment (PPE) was (Gongolong 16.7% and Alau 11.1%), utilizing gloves, masks, and eye protection during pesticide applications. The consideration of wind direction during pesticide application suggests that farmers are aware of the potential for drift and environmental contamination. The use of PPE stresses the significance of protecting human health during pesticide applications.

The results agree with the findings of Ganzelmeier *et al.* (1995), which suggested that wind direction is an important factor in pesticide application, as it can affect the drift of pesticides onto non-target areas, including water sources and neighboring crops. PPE, such as gloves and protective clothing, can reduce dermal exposure to pesticides, which is an important route of exposure for farmers (Krieger, 2001).

Having appropriate knowledge and safe behavior in different stages of working with pesticides, such as purchase, storage, composition, spraying, and proper disposal of their waste, has been emphasized to prevent health-threatening risks (Ghalavandi *et al*., 2018). However, a study in China revealed that even with adequate knowledge about pesticides, many farmers did not use appropriate protective equipment when using pesticides (Fan *et al*., 2015).

Another study in Iran also found that a small number of farmers (8.9%) had safe behaviors in using personal protective equipment when working with pesticides. In addition, although farmers attach great importance to all

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components of safety behavior, in practice, due to various barriers such as lack of access and financial problems, they did not show any interest in safety behaviors when working with pesticides (Sharifzadeh *et al*., 2019).

- *Methods and Time of Application of Pesticides*

The data indicate that spraying was the predominant pesticide application method in both Alau (51.4%) and Gongolong (48.6%). The widespread adoption of spraying as a pesticide application method could be credited to its efficiency and effectiveness in covering large areas.

Matthews (2018) concluded that spraying equipment is often readily available and easy to use, making it a convenient option for farmers. Spraying allows for uniform coverage of the target area, ensuring that the pesticide is evenly distributed and effective against pests. This author, Dent (2000), added that spraying is an effective method for controlling pest populations, as it can reach many pests quickly.

The respondents in both Alau (31.9%) and Gongolong (19.4%) applied pesticides during the fruiting stage of crop development. This suggests that farmers in both locations prioritize pest control during this important stage to protect their crops and ensure ideal yields. Following the fruiting stage, the flowering stage was the second most common time for pesticide application, with a substantial proportion of respondents in both locations reporting application during this stage. Specifically, 18.1% of respondents in Gongolong and 15.3% in Alau applied pesticides during the flowering stage. The flowering stage is another critical period for pesticide application, with a substantial proportion of respondents in both locations reporting application during this stage. Specifically, 18.1% of respondents in Gongolong and 15.3% in Alau applied pesticides during the flowering stage. The growing stage was the minimum time for pesticide application. Explicitly, 11.1% of respondents in Gongolong and 4.2% in Alau applied pesticides during the flowering stage. The high percentage of respondents applying pesticides during the fruiting stage implies that pest pressure was highest during this stage, and farmers are taking measures to protect their crops.

According to Dent (2000), many pests, such as aphids, fruit flies, and whiteflies, are most active during the fruiting stage, and pesticides are used to suppress these pests and reduce damage to the fruit. In the same vein, the findings of Bostanian & Racette (2003) fruits are often more susceptible to pest damage during the fruiting stage, as they are ripening and becoming more attractive to pests. Pesticides applied during the fruiting stage can help protect the yield and quality of the fruit, reducing economic losses for farmers (Potts, 2012).

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ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/25oct405

QUESTIONNAIRE

Assessment of Pesticide Types and Application Practices at Irrigation Sites in Lake Alau and Gongolong, Maiduguri:

➢ *Farmer Information*

- Name: ______________________________________
- Age: ______________________________________
- Educational status: ______________________________
- Sex: ____
- Location: ____________________________________

➢ *Pesticide Use*

- Types of pesticides used:
- - Insecticides: Yes/No
- - Herbicides: Yes/No
- - Fungicides: Yes/No
- Name of pesticide: ___________________________________

➢ *Method of Application:*

- Spraying
- Dusting
- Seed treatment
- Other (specify) ---

➢ *Form of Pesticide:*

- Aerosol
- Solvent
- Dust
- Granule
- Liquid

➢ *Time of Application:*

- Fruiting stage
- Harvesting stage
- Growing stage
- Other (specify) --

➢ *Do You Follow the Instructions on the Pesticide Label?*

- Yes
- No

➢ *Safety Measures Taken During Application (Select all that Apply):*

- Personal protective equipment (PPE) use
- Wind direction consideration
- Buffer zone creation
- Other (specify) --