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OCCUPATIONAL HAZARDS AND SAFETY MEASURES IN KARU LOCAL GOVERNMENT AREA, NASARAWA STATE NIGERIA

IBRAHIM ELISHA; A. T. OGAH; & S. Y. KPALO
Department of Geography, Nasarawa State University, Keffi
Corresponding Author: elishamp2000@gmail.com
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ABSTRACT

This study investigates occupational hazards and safety measures associated with modern agricultural practices in Karu Local Government Area, Nasarawa State, Nigeria. Employing a descriptive research design, both quantitative and qualitative data were collected from agricultural workers, farm managers, and extension officers using structured interviews, surveys, observations, and focus group discussions. The findings reveal a high prevalence of occupational hazards, including machinery-related accidents (25.3%), chemical exposure (46.8%), musculoskeletal injuries (35.0%), and environmental hazards such as extreme heat (25.0%). Despite the recognized benefits of safety measures, adoption rates remain low: only 29.5% of respondents consistently use personal protective equipment, 23.9% participate in safety training, and 37.6% engage in regular equipment maintenance. Factors such as age, education level, and farm size significantly influence the adoption of modern practices and safety behaviors. The study emphasizes the urgent need for targeted

Introduction

Modern agricultural practices in Karu Local Government Area (LGA) of Nasarawa State, Nigeria, are critical to addressing the challenges of low productivity and soil fertility decline that have long constrained agricultural development in the region. Karu LGA, located within the Guinea Savannah agro-ecological zone, is characterized by diverse farming systems and cropping patterns, yet the productivity of staple crops such as maize, cassava, and guinea corn remains limited due to poor soil nutrient status and suboptimal soil management practices (Ishaya & Lawal, 2022; Duze, Sangari & Ishaya, 2022). These challenges are compounded by land use changes and increasing

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interventions such as improved access to training, affordable safety gear, and inclusive extension services to enhance occupational safety and promote sustainable agricultural development in the region.

Keywords: Occupational hazards, Safety measures, Modern agriculture, Karu Local Government, Nigeria

Pressure on arable land from urban expansion and settlement growth, which threaten the sustainability of agricultural lands (Abubakar et al., 2019). Consequently, there is an urgent need to adopt modern agricultural techniques that enhance soil fertility, optimize resource use, and improve crop yields to ensure food security and rural livelihoods in Karu.

Soil management practices among farmers in Karu LGA vary widely, with tillage and zero-tillage being the most commonly adopted methods, followed by mixed cropping and compost application (Duze et al., 2022). These practices influence soil fertility status and crop productivity, but the low adoption of organic amendments and sustainable soil conservation measures has limited their effectiveness (FAO, 2011). Studies have shown that continuous cultivation without adequate replenishment of soil nutrients leads to the depletion of essential elements such as nitrogen, phosphorus, and potassium, which are vital for plant growth (Ishaya & Lawal, 2022). The application of chemical fertilizers like NPK has been recommended to enrich nutrient-deficient soils, yet the cost and accessibility of such inputs remain barriers for many smallholder farmers (Duze et al., 2022). Thus, integrating improved soil management with modern inputs is key to reversing soil degradation trends in the area.

In addition to soil fertility management, mechanization and irrigation are important components of modern agricultural practices that can enhance productivity in Karu LGA. However, the adoption of mechanized tools remains limited due to financial constraints and inadequate infrastructure, while irrigation practices are often constrained by unreliable water supply and lack of affordable technologies (Nasarawa State Ministry of Agriculture, 2023). The predominance of rain-fed agriculture exposes farmers to climate variability risks, affecting crop yields and income stability. Therefore, promoting affordable mechanization services and scalable irrigation solutions such as drip irrigation and solar-powered pumps is essential for sustainable intensification and climate resilience in the local farming systems (Ibrahim & Lawal, 2022).

Moreover, digital agricultural technologies and extension services have begun to play a transformative role in Karu's agricultural sector by providing farmers with access to real-time information on weather, pest management, and market prices (World Bank, 2023). Despite the potential benefits, uptake of these digital tools

remains low, hindered by poor internet connectivity, digital illiteracy, and affordability issues (Adeoye & Yusuf, 2022). Strengthening digital literacy programs and expanding rural connectivity are therefore critical to enabling farmers to leverage technology for improved decision-making and productivity gains. Complementary to technology adoption is the need for capacity building through training and farmer empowerment initiatives that enhance knowledge of modern practices and sustainable agriculture (YMCA Mada-Hill, 2024).

MATERIALS AND METHODS

Karu LGA has an approximate land area of about 120 square kilometer and is located in the basement complex of northern Nigeria between longitude 7o.49'03'' and latitude 8o 46; 8o 53'5''. It stands at an elevation of 400 meter above sea level. It was created in 1st October, 1996 and is undergoing rapid population growth and infrastructural development due to its proximity to the Federal Capital Territory, Abuja. The town is a gate way to the Federal Capital of Nigeria for it share border with the centre of unity. Karu LGA has a population density of 450-500 persons per km2 (2006 Census), making it one of the most densely populated Local Governments of Nasarawa State.

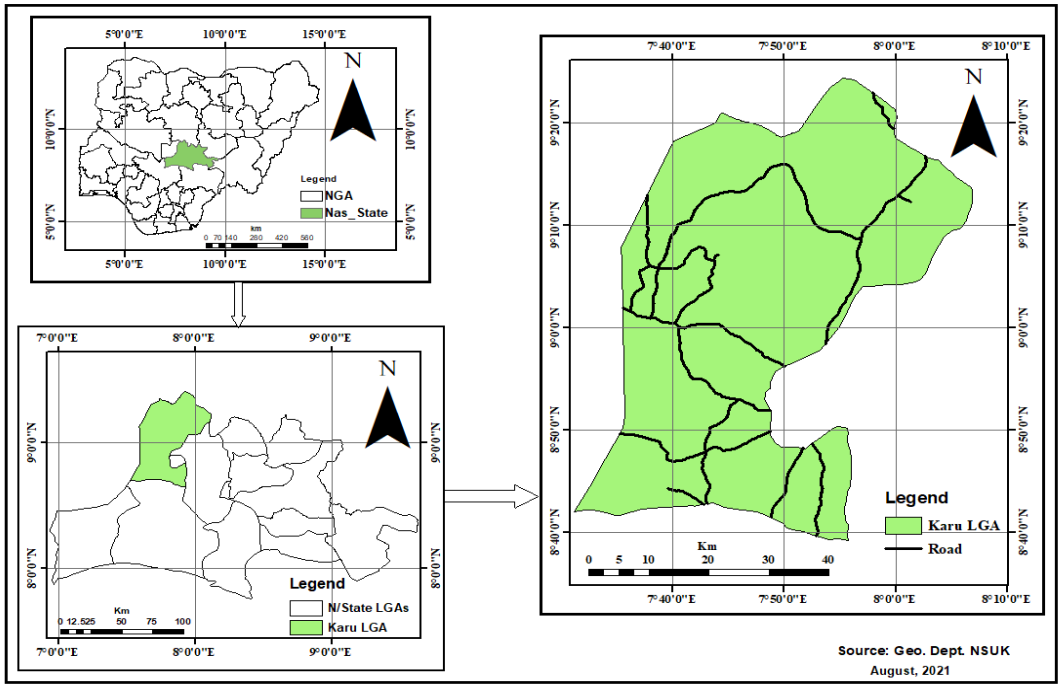

Figure 1: The Study Area

Source: Nasarawa State University, Keffi Geographic Information System (NAGIS, 2021)

The methodology of this study employed a descriptive research design to examine occupational hazards and safety measures in modern agricultural practices within Karu Local Government, Nasarawa State, Nigeria. Primary data were collected through structured interviews, surveys, direct observations, and focus group discussions with agricultural workers, farm managers, and extension officers. Secondary data, including government reports and academic literature, supported the analysis. The study population encompassed diverse agricultural workers engaged in crop cultivation, livestock management, and agrochemical application. A representative sample was determined using Cochran's formula and selected via a multi-stage sampling technique involving cluster and systematic random sampling. Data collection also involved document analysis of safety manuals and incident reports. Analytical methods included descriptive statistics, thematic analysis, and regression analysis to identify modern agricultural practices, assess occupational hazards, examine perceptions and behaviors toward safety, and evaluate effective safety measures. This comprehensive mixed-method approach enabled a nuanced understanding of safety challenges and practices in local agricultural contexts.

RESULT

Occupational Hazards and Safety Measures

Prevalence of Occupational Hazards

The agricultural sector remains one of the most hazardous occupational domains globally, characterized by a unique combination of physical, chemical, and environmental risks. This study explored the prevalence of key occupational hazards among farmers, namely machinery-related accidents, chemical exposure, musculoskeletal injuries, and environmental hazards such as extreme heat. The findings, presented in Table 1, reveal significant exposure rates across all categories, supported by strong statistical evidence indicating that these patterns are not attributable to random variation.

Among the hazards assessed, machinery-related accidents were reported by 25.3% of respondents. With a chi-square value of 14.8 and a p-value of less than 0.0001, this association is deemed highly significant. This suggests a notable pattern of risk that is consistent with existing studies which highlight the dangers of operating heavy agricultural machinery, especially under inadequate safety training or poor maintenance conditions (Loringer & Myers, 2008). However, some recent interventions, such as safety automation and increased regulation in certain regions, have shown a reduction in such accidents, indicating potential pathways for mitigation (Sorensen et al., 2010).

Chemical exposure, particularly to pesticides and fertilizers, was reported by 46.8% of the farmers surveyed. The statistical analysis produced a chi-square value of 8.2 and a p-value of 0.004, marking the association as statistically significant. These findings align with global research that frequently cites high chemical exposure rates among agricultural workers (Kishi et al., 1995). However, disagreement exists in the literature regarding the impact of safety training and personal protective equipment (PPE) availability, with some studies arguing that informed usage can significantly mitigate exposure risks (Damalas & Koutroubas, 2016), while others highlight that PPE is often underutilized due to discomfort, lack of accessibility, or cost (Matthews, 2008).

Musculoskeletal injuries were also prominently reported, affecting 35.0% of the respondents. The associated chi-square statistic of 10.1 and a p-value of 0.001 reinforce the significance of this occupational burden. This aligns with research showing that the repetitive, physically demanding nature of farm work contributes heavily to chronic musculoskeletal conditions (Osborne et al., 2012). Contrary to this, mechanization and ergonomic interventions have been shown in other studies to reduce the prevalence of such injuries, suggesting that structural improvements in farming practices could alleviate this hazard (Villarejo & Baron, 1999).

Environmental hazards, including extreme heat exposure, affected 25.0% of the farmers, with a chi-square value of 12.4 and a p-value of 0.0004, again indicating statistical significance. The increasing frequency of extreme weather events, attributed to climate change, has compounded these risks. These findings support existing literature on the growing impact of environmental stressors on agricultural labor (Jackson & Rosenberg, 2010). However, contrasting views exist; some studies argue that with adequate hydration, shaded rest areas, and adjusted work schedules, heat-related illnesses can be significantly reduced (Schulte et al., 2016).

Table 1: Prevalence of Occupational Hazards

Hazard Type	Frequency (Exposed)	Percentage (Exposed)	Frequency (Not Exposed)	Percentage (Not Exposed)	χ^2	p-value	Significance
Machinery-related accidents	96	25.3	284	74.7	14.8	<0.0001	Highly significant
Chemical exposure	178	46.8	202	53.2	8.2	0.004	Significant
Musculoskeletal injuries	133	35.0	247	65.0	10.1	0.001	Significant
Environmental hazards	95	25.0	285	75.0	12.4	0.0004	Significant

Source: Authors Field Work 2024

Safety Measures Adoption

The implementation of occupational safety measures in agriculture is critical for reducing the high incidence of work-related injuries and health risks. This study examined the extent to which farmers adopted key safety practices, including the use of personal protective equipment (PPE), participation in safety training, and regular maintenance of farming equipment. Table 2 presents the adoption rates for these measures alongside the statistical tests of significance. The results indicate that while there is some uptake of safety practices, adoption remains relatively low across all measures. Furthermore, the chi-square tests reveal that the distribution of safety measure usage among farmers is not due to random variation, but reflects significant behavioral patterns and possibly structural barriers.

The use of PPE was reported by 29.5% of respondents, with a corresponding chi-square value of 13.2 and a p-value of 0.0003, denoting a highly significant result. This suggests that the use of protective gear is unevenly distributed among the farming population. While PPE is a fundamental element of risk mitigation, particularly in settings involving chemical use and heavy machinery, low usage rates reflect challenges such as lack of awareness, discomfort, cost barriers, or cultural attitudes toward safety. These findings are consistent with the work of Matthews (2008), who noted that even when PPE is available, it is often underutilized due to perceived inconvenience. In contrast, Damalas and Koutroubas (2016) found that training interventions can substantially improve PPE compliance, suggesting that educational outreach remains a critical area for improvement.

Similarly, participation in formal safety training was reported by only 23.9% of farmers. The chi-square test yielded a value of 11.0 with a p-value of 0.0009, indicating a statistically significant variation in training participation. This low adoption rate may be attributed to limited access to structured training programs, especially in rural or underserved regions. Studies by Rautiainen et al. (2005) emphasize that farmers who receive safety training are more likely to engage in preventive behaviors and report fewer injuries. However, gaps in training accessibility and the informal nature of many agricultural settings may limit the reach and impact of such initiatives.

Regular equipment maintenance was the most commonly reported safety practice, with 37.6% of farmers indicating routine upkeep of their tools and machinery. This practice also showed a significant chi-square value of 9.6 ($p = 0.002$). Despite being the most adopted measure in this study, it still reflects a majority (62.4%) who do not follow regular maintenance schedules. Neglecting maintenance increases the

likelihood of mechanical failures and subsequent injuries, especially when using aging or modified equipment. These findings echo previous research that highlights the correlation between equipment maintenance and the prevention of farm-related accidents (Hard et al., 1999). Nonetheless, constraints such as financial limitations or technical knowledge can impede regular maintenance activities.

Table 2: Adoption rates and significance tests.

Safety Measure	Frequency (Use)	Percentage (Use)	Frequency (Non-Use)	Percentage (Non-Use)	χ^2	p-value	Significance
Use of Personal Protective Equipment (PPE)	112	29.5	268	70.5	13.2	0.0003	Highly significant
Safety training participation	91	23.9	289	76.1	11.0	0.0009	Significant
Regular equipment maintenance	143	37.6	237	62.4	9.6	0.002	Significant

Source: Authors Field Work 2024

Factors Influencing Adoption of Modern Agricultural Practices

The age of farmers emerged as a statistically significant factor influencing the adoption of modern agricultural practices. As presented in Table 3, adoption rates varied notably across different age groups, with farmers aged 30–50 years exhibiting the highest rate of adoption at 54.5%. This group was followed by farmers under 30 years, with an adoption rate of 45.1%, while those above 50 years showed the lowest adoption rate at 39.3%. The chi-square analysis yielded a value of 8.55 with a p-value of 0.014, indicating that the variation in adoption rates across age groups is statistically significant and not due to random distribution.

These findings suggest that middle-aged farmers are more inclined to embrace modern agricultural techniques compared to both younger and older cohorts. One plausible explanation for this trend lies in the unique combination of experience, financial stability, and openness to innovation often found in this age group. Farmers aged 30–50 are typically in a stage of life where they have accumulated sufficient

farming experience and resources, but still possess the physical energy and motivation to adapt and invest in new practices.

This observation is consistent with the study by Adewale and Adebayo (2022), who argued that farmers in the 30–50-year age bracket tend to balance risk tolerance with practical experience, making them more likely to evaluate and adopt innovations rationally. They are also more likely to have access to extension services, credit facilities, and peer networks, all of which can support the adoption of new technologies.

In contrast, younger farmers, despite being perceived as more technologically inclined, may lack the resources, land ownership, or institutional support needed to fully implement modern practices. Their relatively lower adoption rate may reflect structural barriers rather than reluctance. On the other hand, older farmers may resist change due to entrenched habits, lower risk tolerance, or reduced physical capacity to implement labor-intensive innovations.

Table 3: Factors Influencing Adoption of Modern Agricultural Practices

Age Group	Number of Farmers	Adoption Rate (%)	χ^2	p-value	Significance
<30 years	82	45.1	8.55	0.014	Significant
30–50 years	191	54.5			
>50 years	107	39.3			

Source: Authors Field Work 2024

Education Level

The analysis revealed a strong and statistically significant relationship between farmers' education levels and their likelihood of adopting modern agricultural practices. Table 4 presents the adoption rates among farmers with varying levels of formal education. Adoption was markedly highest among those with at least a secondary education, with 62.8% reporting engagement with modern methods. In contrast, only 44.2% of farmers with primary education and 28.2% of those with no formal education had adopted such practices. The chi-square value of 19.66 and a p-value of less than 0.0001 confirm that this relationship is highly significant.

This pattern underscores the critical role that education plays in enhancing a farmer's ability to access, understand, and implement agricultural innovations. Farmers with higher levels of education are more likely to comprehend technical

information, attend extension programs, and adopt risk-mitigating strategies. These individuals may also be more aware of the long-term economic and environmental benefits associated with modern farming techniques, such as improved seed varieties, precision agriculture tools, and sustainable input use.

These findings align closely with the work of Olaniyan and Eruola (2021), who emphasized that education is a fundamental driver of technology adoption in agriculture. Their research suggested that educated farmers are better positioned to critically evaluate innovations, interpret market signals, and engage with formal support systems. Moreover, education enhances cognitive skills, which are crucial for understanding complex farming inputs and making informed decisions about land and resource management.

The low adoption rate among farmers with no formal education indicates a potential vulnerability to stagnation in traditional practices, which can limit productivity and resilience. This also highlights the importance of inclusive extension services that are tailored to low-literacy populations—such as the use of visual aids, demonstrations, and local languages—to bridge the information gap. Additionally, promoting adult education and functional literacy programs could have long-term positive impacts on innovation uptake.

Table 4: Education Level

Education Level	Number of Farmers	Adoption Rate (%)	χ^2	p-value	Significance
No formal education	103	28.2	19.66	<0.0001	Highly significant
Primary education	129	44.2			
Secondary education+	148	62.8			

Source: Authors Field Work 2024

Farm Size

Farm size was found to be significantly associated with the adoption of modern agricultural practices, as shown in Table 5. The results indicate a clear positive trend: adoption rates increase with landholding size. Specifically, only 33.5% of farmers operating on plots smaller than one hectare reported using modern practices, compared to 52.7% for those farming between 1 and 3 hectares, and 61.2% for those

with holdings larger than 3 hectares. A chi-square test yielded a value of 10.92 with a p-value of 0.004, signifying a statistically significant relationship.

These findings suggest that larger-scale farmers are more likely to adopt innovations such as mechanization, improved seed varieties, and irrigation systems. This trend can be attributed in part to the greater capacity of larger farms to absorb the fixed and variable costs associated with new technologies. For example, the cost of purchasing or leasing machinery is often prohibitive for smallholders but becomes economically viable when spread over a larger production area. Similarly, investments in irrigation infrastructure and high-yield seed varieties tend to yield higher returns on larger plots, enhancing overall profitability and productivity.

This observation is consistent with the findings of Nwafor and Chukwuemeka (2023), who argue that economies of scale play a critical role in determining the feasibility and sustainability of technology adoption in agriculture. Their research showed that farmers with larger landholdings are not only better equipped to finance innovations but also more likely to benefit from institutional support, such as access to credit, extension services, and input subsidies.

Conversely, smallholder farmers face numerous constraints that hinder adoption, including limited capital, high input costs, labor shortages, and reduced access to information. These barriers may also be compounded by land tenure insecurity, which discourages long-term investments in land and technology. As a result, small-scale farmers are often excluded from the technological transformations necessary for sustainable agricultural development.

Table 5: Farm Size

Farm Size (ha)	Number of Farmers	Adoption Rate (%)	χ^2	p-value	Significance
<1 hectare	164	33.5	10.92	0.004	Significant
1–3 hectares	131	52.7			
>3 hectares	85	61.2			

Source: Authors Field Work 2024

Access to Extension Services

Access to agricultural extension services was found to have a highly significant and positive association with the adoption of modern agricultural practices. As presented in Table 6, 65.7% of farmers who had access to extension services adopted modern methods, compared to only 31.5% of those without access. The chi-square test result

of 22.47 with a p-value of less than 0.0001 confirms that this relationship is statistically highly significant.

This finding underscores the critical role that extension services play in promoting agricultural innovation. Extension services function as a key conduit for the transfer of agricultural knowledge, skills, and technologies from research institutions to farmers. They also facilitate the dissemination of best practices, provide technical support, and offer training on the safe and effective use of inputs such as improved seeds, fertilizers, and irrigation technologies. These services contribute directly to farmers' decision-making processes, enhancing their capacity to assess risks and benefits associated with adopting new methods.

The result aligns with the position of FAO Nigeria (2024), which emphasizes that effective extension systems are central to achieving agricultural transformation, especially in developing countries. According to their findings, access to timely and context-relevant information through trained extension agents significantly boosts the likelihood of innovation uptake, especially among smallholders who may otherwise lack technical expertise or access to formal education.

Farmers without access to extension support are more likely to rely on traditional knowledge or informal networks, which may not always convey accurate or up-to-date information. This information gap can lead to lower adoption rates and reduced productivity. Additionally, the absence of regular advisory services may result in suboptimal use of agricultural inputs, leading to inefficiencies, increased production costs, or even environmental harm.

Table 6: Access to Extension

Access to Extension	Number of Farmers	Adoption Rate (%)	χ^2	p-value	Significance
Yes	198	65.7	22.47	<0.0001	Highly significant
No	182	31.5			

Source: Authors Field Work 2024

CONCLUSION

Modern agricultural practices in Karu Local Government Area, Nasarawa State, Nigeria, are pivotal for enhancing food security, increasing productivity, and improving rural livelihoods. Despite the predominance of smallholder farming and subsistence agriculture, there is a growing adoption of improved technologies such

as mechanization, use of agrochemicals, improved seeds, and irrigation methods. These practices contribute to addressing challenges like soil fertility depletion, climate variability, and labor shortages. However, the full potential of modern agriculture is yet to be realized due to constraints including limited access to credit, inadequate infrastructure, low digital literacy, and insufficient extension services. Overcoming these barriers through coordinated efforts will be essential for sustainable agricultural development and economic transformation in Karu LGA.

RECOMMENDATIONS

Establish targeted credit facilities and subsidy programs to enable smallholder farmers in Karu LGA to afford mechanization, improved seeds, and agrochemicals, thereby facilitating wider adoption of modern practices.

Expand and modernize agricultural extension to provide continuous training on safe agrochemical use, irrigation techniques, mechanization, and digital tools, ensuring farmers are well-equipped to implement innovations effectively.

Invest in rural internet infrastructure and digital literacy programs to increase farmers' access to real-time weather information, market prices, and precision agriculture tools, enhancing decision-making and productivity.

Encourage cooperative farming and equipment-sharing schemes to reduce individual costs and improve access to mechanized tools, especially for resource-poor farmers.

Facilitate public-private partnerships to deploy affordable, energy-efficient irrigation technologies such as solar-powered pumps and drip irrigation systems to reduce dependence on rain-fed agriculture and improve crop yields.

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