

Identifying and Addressing Ergonomic Hazards in the Application of Agrochemicals in Agricultural Farms in Imo State

¹Felistas E. Nwarieji & ²Orusha Joshoua

^{1&2}Department of Agricultural Education,
Alvan Ikoku Federal College of Education Owerri

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Abstract

This study examined ergonomic hazards associated with agrochemical application among agricultural workers in Imo State, Nigeria. A descriptive survey design was adopted involving 78 respondents, comprising 50 farmers and 28 agricultural extension agents. Data were collected using a structured questionnaire and analyzed using mean statistics and Analysis of Variance (ANOVA) at the 0.05 significance level. Findings revealed that musculoskeletal disorders, chemical poisoning, reproductive health risks, and joint-related ailments were the major ergonomic hazards. Manual spraying and chemical mixing were identified as the most hazardous application activities, while inadequate safety training and inconsistent use of personal protective equipment increased occupational risks. ANOVA results showed no significant differences between farmers and extension agents regarding the identified hazards and recommended safety measures. The study concluded that ergonomic hazards negatively affect workers' health and productivity, recommending regular safety training, ergonomic risk assessments, appropriate application equipment, and strict enforcement of personal protective equipment use.

Keywords: *Ergonomic hazards, Agrochemical application, Agricultural workers, Occupational safety*

Corresponding Author:

Felistas E. Nwarieji

Background to the Study

Ergonomics is the scientific discipline concerned with understanding the interactions between humans and other elements of a work system to optimize workers' safety, health, comfort, and productivity. Applies scientific principles to the design of work environments, equipment, tools, and tasks so that they match human capabilities and limitations. According to the International Ergonomics Association (IEA, 2020), ergonomics optimizes both human well-being and overall system performance through the application of scientific knowledge. In agriculture, ergonomics has become increasingly important because farming activities expose workers to a range of physical, chemical, and environmental hazards that can adversely affect their health and work efficiency (ILO, 2022; Mishra et al., 2024).

Ergonomic hazards are workplace conditions that place excessive physical or physiological demands on workers, increasing the likelihood of musculoskeletal disorders, fatigue, injuries, and long-term health complications. These hazards commonly arise from repetitive movements, awkward working postures, prolonged standing or bending, excessive force, vibration, manual handling of heavy loads, and poorly designed tools or equipment. In agricultural production systems, ergonomic hazards are often intensified by labour-intensive practices, inadequate mechanization, and unsafe work environments (Joshi et al., 2024; Mishra et al., 2024). The identification of these hazards is essential because it provides the basis for developing appropriate interventions that improve occupational safety and enhance productivity.

The application of agrochemicals is one of the most hazardous agricultural operations and requires considerable ergonomic attention. Agrochemicals—including pesticides, herbicides, fungicides, insecticides, and fertilizers—are widely used to improve crop productivity, control pests, and reduce crop losses (FAO & WHO, 2024). Although these chemicals contribute significantly to agricultural production, their handling, mixing, transportation, loading, and application expose workers to numerous ergonomic and occupational health risks. Workers frequently carry heavy knapsack sprayers, maintain awkward postures while spraying, walk long distances over uneven terrain, and perform repetitive arm and shoulder movements for extended periods (Joshi et al., 2024). These physical demands, combined with direct chemical exposure, substantially increase the risk of work-related injuries and illnesses.

In addition to physical strain, improper agrochemical application exposes agricultural workers to acute and chronic health effects. According to the World Health Organization (WHO, 2024), unsafe pesticide handling contributes to poisoning, respiratory diseases, skin disorders, neurological impairment, reproductive health problems, and certain cancers. Pesticide exposure remains a major public health concern among agricultural workers in developing countries, with inadequate use of personal protective equipment significantly increasing occupational risks (Belay et al., 2024). Acute symptoms such as dizziness, headaches, eye irritation, nausea, skin irritation, and breathing difficulties frequently occur among workers who lack appropriate training or fail to use personal protective equipment (Belay et al., 2024; Nguyen Cong Thanh & Unger, 2024). Furthermore, the Food and Agriculture Organization emphasized that poor agrochemical management threatens

workers' health, environmental quality, food safety, and sustainable agricultural production (FAO, 2021).

Agriculture remains one of the most hazardous occupations worldwide, particularly in developing countries where farming depends largely on manual labour and limited mechanization. Agricultural workers routinely perform physically demanding tasks under extreme weather conditions while using inadequate protective equipment and receiving limited occupational health support (ILO, 2022). These occupational risks are further aggravated by insufficient safety education, weak regulatory enforcement, poverty, and poor access to modern farming technologies (World Bank, 2020; Belay et al., 2024). Addressing ergonomic hazards in agrochemical application requires comprehensive interventions that combine engineering improvements, administrative controls, behavioural change, and occupational safety education. Ergonomic interventions include the use of lightweight and ergonomically designed spraying equipment, improved work organization, regular safety training, scheduled work-rest cycles, proper maintenance of application equipment, and consistent use of appropriate personal protective equipment (FAO & WHO, 2024). Studies have demonstrated that ergonomic education and improved work practices significantly reduce occupational risks while increasing workers' productivity and well-being (Vyas & Singh, 2008; Mishra et al., 2024). Similarly, the International Labour Organization (ILO, 2021) emphasized that strengthening occupational safety programmes and ergonomic practices substantially reduces work-related injuries in agriculture.

Despite the recognized importance of ergonomics, its application in Nigerian agriculture remains inadequate. Many farmers continue to use manually operated spraying equipment, apply agrochemicals without adequate protective clothing, and receive little or no formal training on safe handling practices. Low awareness of ergonomic principles, inadequate extension services, limited institutional support, poor enforcement of occupational safety regulations, and financial constraints have slowed the adoption of safer technologies and work practices (World Bank, 2020; FAO & WHO, 2025). Consequently, many agricultural workers remain vulnerable to preventable ergonomic injuries and agrochemical-related illnesses.

In Imo State, agriculture is a major source of employment and household income, with farmers relying heavily on agrochemicals to improve crop production. However, the increasing use of agrochemicals without corresponding improvements in ergonomic practices and occupational safety raises significant public health concerns. Many farmers continue to apply chemicals using inappropriate equipment, unsafe work methods, and inadequate personal protective equipment, thereby increasing their exposure to musculoskeletal injuries and chemical-related illnesses (Belay et al., 2024). Despite these risks, empirical evidence on ergonomic hazards associated with agrochemical application in agricultural farms in Imo State remains limited.

Therefore, identifying the specific ergonomic hazards associated with agrochemical application and developing practical strategies for addressing them are essential for improving occupational safety, protecting workers' health, increasing agricultural productivity, and

promoting sustainable agricultural development. Integrating ergonomic principles into agricultural systems contributes to improved worker well-being, higher productivity, safer food production, and environmental sustainability (Brunelle et al., 2024; UNEP, 2021). This study therefore seeks to identify the ergonomic hazards associated with agrochemical application on agricultural farms in Imo State, examine existing safety practices, and recommend appropriate ergonomic interventions to contribute to safer, healthier, and more productive agricultural workplaces.

Purpose of the Study

1. Assess the prevalence of ergonomic hazards encountered by agricultural workers during the application of agrochemicals in Imo State.
2. Identify the specific tasks within the application of agrochemicals that pose the highest risk of ergonomic injury or strain.
3. Explore the perceptions and experiences of agricultural workers regarding ergonomic hazards and safety practices in agrochemical application.
4. Evaluate the existing ergonomic interventions or safety measures implemented in agricultural farms in Imo State to mitigate hazards associated with agrochemical application.
5. Develop strategies to address ergonomic hazards and promote safer practices in the application of agrochemicals on agricultural farms in Imo State.

Research Question

1. What is the prevalence of ergonomic hazards encountered by agricultural workers in Imo State during the application of agrochemicals?
2. What are the activities involved in the application of agrochemicals that present the highest risk of ergonomic injury or strain to agricultural workers in Imo State?
3. What are the perceptions and experiences of agricultural workers regarding ergonomic hazards and safety practices during the application of agrochemicals?
4. How effective are the existing ergonomic interventions and safety measures implemented in agricultural farms in Imo State in mitigating hazards associated with the application of agrochemicals?
5. What strategies have been developed to address ergonomic hazards and promote safer practices in the application of agrochemicals in agricultural farms in Imo State?

Hypotheses

H_{0,1}: There is no significant difference between the mean responses of the farmers and extension agents on the prevalence of ergonomic hazards encountered by agricultural workers during the application of agrochemicals in Imo State.

H_{0,2}: There is no significant difference between the mean responses of the farmers and extension agents on the specific tasks within the application of agrochemicals that pose the highest risk of ergonomic injury or strain.

H₀: There is no significant difference between the mean responses of the farmers and extension agents on the existing ergonomic interventions or safety measures implemented in agricultural farms in Imo State to mitigate hazards associated with agrochemical application

Materials and Methods

Five research questions were developed to guide the study. The study was carried out in Imo State. The study population comprised 78 individuals: 50 registered small farmers and 28 extension agents. The instrument used for data collection was a 30-item questionnaire. The questionnaire items had a 5-point response scale: very strongly agreed (SA), Agreed (A), strongly disagreed (SD), and disagreed (D), with corresponding weights of 5, 4, 3, and 2. The instrument was face-validated by three university lecturers: two from the Department of Industrial Chemistry and one from the Department of Vocational Teacher Education, all from the University of Nigeria, Nsukka. The validators' suggestions were used to improve the final draft of the questionnaire. The entire 78 copies administered were retrieved and analyzed using simple percentages and frequencies. In addition, the chi-square test and one-way analysis of variance (ANOVA) were used to test the null and alternative hypotheses. In addition, a five percent (5%) level of significance was used in the research work at the calculated degree of freedom. Chi-Square is given by:

$\chi^2 = \sum \frac{(O - E)^2}{E}$ Where „O“ = observed frequency of any value; χ^2 = Chi-Square
„E“ = Expected frequency given by:

Degree of freedom (df) is given by: (Row -1) x (Column – 1).

Decision Rule: 1. If calculated $\chi^2 >$ tabulated χ^2 at a calculated degree of freedom, reject H₀. 2. If the calculated significance level is <5%, reject H₀. Otherwise, accept H₀.

Questionnaire Items

Research Question 1: What is the prevalence of ergonomic hazards encountered by agricultural workers in Imo State during the application of agrochemicals?

Table 1.

S/N	ITEMS	S/A	A	S/D	D	Mean (x)	Decision
1	Reproductive toxicity	26 (33.3%)	32 (41.0%)	12 (15.4%)	8 (10.3%)	3.97	Agreed
2	pain in the back, shoulder, wrist, elbow, hip, knees, and ankle	38 (48.7%)	30 (38.5%)	6 (7.7%)	4 (5.1%)	4.31	Strongly Agreed
3	poisoning, collective contamination	34 (43.6%)	28 (35.9%)	10 (12.8%)	6 (7.7%)	4.15	Agreed
4	Risks for male sterility	22 (28.2%)	30 (38.5%)	16 (20.5%)	10 (12.8%)	3.82	Agreed
5	hip and knee osteoarthritis	28 (35.9%)	34 (43.6%)	10 (12.8%)	6 (7.7%)	4.08	Agreed
Grand Mean						4.07	Agreed

Table 1 shows that ergonomic hazards are common among farm workers in Imo State. Back and joint pains had the highest mean (4.31), followed by poisoning (4.15). The grand mean (4.07) indicates that most respondents agreed that hazards are widespread.

Research Question 2: What are the activities involved in the application of agrochemicals that present the highest risk of ergonomic injury or strain to agricultural workers in Imo State?

Table 2.

S/N	ITEMS	S/A	A	S/D	D	Mean (x)	Decision
1	Manual spraying	40 (51.3%)	26 (33.3%)	8 (10.3%)	4 (5.1%)	4.31	Strongly Agreed
2	Mixing and loading chemicals	34 (43.6%)	32 (41.0%)	8 (10.3%)	4 (5.1%)	4.23	Agreed
3	Operating heavy machinery	26 (33.3%)	34 (43.6%)	12 (15.4%)	6 (7.7%)	3.99	Agreed
4	Handling residues and waste	28 (35.9%)	30 (38.5%)	12 (15.4%)	8 (10.3%)	3.91	Agreed
5	Refilling equipment	24 (30.8%)	36 (46.2%)	12 (15.4%)	6 (7.7%)	3.95	Agreed
	Grand Mean					4.08	Agreed

Table 2 indicates that manual spraying recorded the highest mean (4.31), showing it is the most stressful task. Mixing and loading of chemicals (4.23) and operating heavy machinery (3.99) also expose workers to strain. The grand mean (4.08) confirms that several activities during agrochemical use pose high ergonomic risks in Imo State farms.

Research Question 3: What are the perceptions and experiences of agricultural workers regarding ergonomic hazards and safety practices during the application of agrochemicals?

Table 3.

S/N	ITEMS	S/A	A	S/D	D	Mean ($\bar{x}$)	Decision
1	Many agricultural workers are aware of the ergonomic risks associated with the task	30 (38.5%)	32 (41.0%)	10 (12.8%)	6 (7.7%)	4.10	Agreed
2	Lack of detailed knowledge about specific hazards and effective safety practices	34 (43.6%)	30 (38.5%)	8 (10.3%)	6 (7.7%)	4.18	Agreed
3	Training on ergonomic safety is often inadequate, leading to a limited understanding of how to prevent injuries	38 (48.7%)	28 (35.9%)	8 (10.3%)	4 (5.1%)	4.28	Strongly Agreed
4	Workers often perceive the risk of ergonomic injuries as part of their job	26 (33.3%)	34 (43.6%)	10 (12.8%)	8 (10.3%)	3.99	Agreed
5	Adherence to safety practices is inconsistent	36 (46.2%)	28 (35.9%)	8 (10.3%)	6 (7.7%)	4.20	Agreed
Grand Mean						4.15	Agreed

Table 3 shows that most respondents agreed that training on ergonomic safety is inadequate (4.28). They also admitted poor knowledge of specific hazards (4.18) and irregular adherence to safety rules (4.20). The grand mean (4.15) indicates that workers have a limited understanding of ergonomic hazards and weak compliance with safety practices during agrochemical application.

Research Question 4: How effective are the existing ergonomic interventions and safety measures implemented in agricultural farms in Imo State in mitigating hazards associated with the application of agrochemicals?

Table 4.

S/N	ITEMS	S/A	A	S/D	D	Mean ($\bar{x}$)	Decision
1	Training programs that educate workers on the proper use of ergonomic tools can reduce the incidence of musculoskeletal injuries	34 (43.6%)	32 (41.0%)	8 (10.3%)	4 (5.1%)	4.23	Agreed
2	Personal protective equipment (PPE) can protect against chemical exposure and some ergonomic hazards if used correctly	36 (46.2%)	28 (35.9%)	8 (10.3%)	6 (7.7%)	4.23	Agreed
3	Farms with strong safety cultures have more ergonomic interventions	28 (35.9%)	34 (43.6%)	10 (12.8%)	6 (7.7%)	4.03	Agreed
4	Ongoing monitoring of workers' practices and health can help in identifying issues early	30 (38.5%)	32 (41.0%)	10 (12.8%)	6 (7.7%)	4.03	Agreed
5	Advanced technologies such as automated spraying systems, drones and mechanized equipment can significantly reduce ergonomic risks	24 (30.8%)	34 (43.6%)	12 (15.4%)	8 (10.3%)	3.95	Agreed
Grand Mean						4.09	Agreed

Table 4 shows that training programs (4.23) and proper use of PPE (4.23) were rated as the most effective ergonomic measures. Monitoring of workers (4.03) and farm safety culture (4.03) also contributed to risk reduction. The grand mean (4.09) indicates that existing ergonomic interventions on Imo State farms are fairly effective but require improvement and consistent implementation.

Research Question 5: What are the strategies developed to address ergonomic hazards and promote safer practices in the application of agrochemicals in agricultural farms in Imo State?

Table 5.

S/N	ITEMS	S/A	A	S/D	D	Mean ($\bar{x}$)	Decision
1	Implementing regular training that educates farm workers on ergonomic principles	38 (48.7%)	30 (38.5%)	6 (7.7%)	4 (5.1%)	4.31	Strongly Agreed
2	Provide tools and equipment designed to reduce strain	34 (43.6%)	32 (41.0%)	8 (10.3%)	4 (5.1%)	4.23	Agreed
3	Implementing task rotation to prevent repetitive strain by alternating workers with different tasks	32 (41.0%)	34 (43.6%)	8 (10.3%)	4 (5.1%)	4.21	Agreed
4	Involving farm workers in the identification of ergonomic risks and the development of solutions	30 (38.5%)	36 (46.2%)	8 (10.3%)	4 (5.1%)	4.18	Agreed
5	Conducting regular ergonomic assessments identifies risks and evaluates the effectiveness of implemented strategies	36 (46.2%)	30 (38.5%)	8 (10.3%)	4 (5.1%)	4.26	Agreed
Grand Mean						4.24	Agreed

Table 5 shows that regular training (4.31) and ergonomic assessments (4.26) were the most agreed-upon strategies for improving farm safety. The provision of ergonomic tools (4.23) and task rotation (4.21) were also important. The grand mean (4.24) indicates that respondents strongly support continuous training and ergonomic planning to reduce hazards in farm work.

Results

Test of Hypothesis

H₀: There is no significant difference between the mean responses of the farmers and extension agents on the prevalence of ergonomic hazards encountered by agricultural workers during the application of agrochemicals in Imo State

Table 6.

Source of Variation	Sum of Squares	df	Mean Square	F-cal	F-tab (0.05)	Decision
Between Groups	5.63	1	5.63	4.28	3.96	Reject H ₀
Within Groups	99.92	76	1.31			
Total	105.55	77				

Since F-cal (4.28) > F-tab (3.96) at 0.05 level of significance, the null hypothesis is rejected. This means that there is a significant difference between the mean responses of farmers and extension agents on the prevalence of ergonomic hazards during agrochemical application in Imo State.

H0₂: There is no significant difference between the mean responses of the farmers and extension agents on the specific tasks within the application of agrochemicals that pose the highest risk of ergonomic injury or strain.

Table 7.

Source of Variation	Sum of Squares	df	Mean Square	F-cal	F-tab (0.05)	Decision
Between Groups	4.92	1	4.92	3.65	3.96	Accept H ₀
Within Groups	102.84	76	1.35			
Total	107.76	77				

Since F-cal (3.65) < F-tab (3.96) at the 0.05 level of significance, the null hypothesis is accepted. This means there is no significant difference in the mean responses of farmers and extension agents to the specific tasks that pose the highest ergonomic risk.

H0₃: There is no significant difference between the mean responses of the farmers and extension agents on the existing ergonomic interventions or safety measures implemented in agricultural farms in Imo State to mitigate hazards associated with agrochemical application.

Table 8.

Source of Variation	Sum of Squares	df	Mean Square	F-cal	F-tab (0.05)	Decision
Between Groups	6.37	1	6.37	4.61	3.96	Reject H ₀
Within Groups	104.91	76	1.38			
Total	111.28	77				

Since F-cal (4.61) > F-tab (3.96) at the 0.05 level of significance, the null hypothesis is rejected. This indicates a significant difference in the mean responses of farmers and extension agents regarding existing ergonomic interventions or safety measures used on agricultural farms.

Discussion of Findings

The findings of this study were discussed in line with the research questions and hypotheses tested.

Prevalence of Ergonomic Hazards (Research Question 1)

The results in Table 1 revealed that ergonomic hazards are highly prevalent among agricultural workers in Imo State during agrochemical application, with a grand mean of 4.07. Among the identified hazards, musculoskeletal pains such as back, shoulder, and joint pains recorded the highest mean (4.31), followed by poisoning and contamination (4.15). Respondents also acknowledged other hazards, such as reproductive toxicity and risks of male sterility. These findings indicate that agricultural workers are exposed to both physical and chemical hazards, which significantly affect their health and productivity. This aligns with reports by the International Labour Organization (2022), which identified agriculture as one of the most

hazardous sectors globally due to exposure to repetitive tasks, awkward postures, and hazardous substances. Similarly, the World Health Organization (2020) reported that exposure to agrochemicals contributes to both acute poisoning and long-term health conditions, including reproductive and neurological disorders. This finding implies that ergonomic hazards are widespread and pose a serious threat to the well-being of farm workers in the study area, thereby necessitating urgent intervention.

Risky Activities in Agrochemical Application (Research Question 2)

Findings from Table 2 showed that several activities involved in agrochemical application pose significant ergonomic risks, with a grand mean of 4.08. Manual spraying had the highest mean (4.31), followed by mixing and loading of chemicals (4.23), while operating machinery and handling residues also contributed to ergonomic strain. This suggests that labour-intensive and repetitive tasks are the primary sources of ergonomic stress among agricultural workers. The finding is consistent with the Food and Agriculture Organization (2021), which emphasized that manual agricultural operations impose high physical strain on workers and increase the risk of injury. Likewise, studies on occupational health in agriculture indicate that tasks involving chemical handling and manual spraying significantly increase the likelihood of musculoskeletal disorders and chemical exposure (ILO, 2022). The implication is that intervention efforts should focus on improving work methods and introducing safer technologies for these high-risk activities.

Workers' Perception and Experience (Research Question 3)

Table 3 revealed that although respondents demonstrated a reasonable level of awareness of ergonomic hazards (mean = 4.10), they lacked detailed knowledge of specific risks and safety practices (mean = 4.18). Training on ergonomic safety was found to be inadequate (mean = 4.28), and adherence to safety practices was inconsistent (mean = 4.20).

This indicates a gap between awareness and practical knowledge, as well as weak compliance with safety measures. This finding supports the United Nations Environment Programme's (2021) position, which noted that awareness alone is insufficient without proper training and institutional support. Similarly, the International Labour Organization (2022) emphasized that inadequate training and poor safety culture contribute significantly to occupational hazards in agriculture.

The implication is that improving training and strengthening safety awareness programmes are critical to enhancing safe practices among agricultural workers.

Effectiveness of Existing Interventions (Research Question 4)

Table 4 indicates that existing ergonomic interventions, such as training programmes and the use of personal protective equipment (PPE), were perceived as fairly effective, both recording a mean of 4.23. Other measures, such as monitoring and safety culture, also contributed to hazard reduction, with a grand mean of 4.09.

However, despite their perceived effectiveness, the persistence of hazards suggests that these interventions are not consistently implemented or adequately enforced. This aligns with

findings by the World Bank (2020), which reported that weak institutional frameworks and poor enforcement limit the effectiveness of occupational safety measures in developing countries. Furthermore, the International Labour Organization (2022) stressed that PPE and training are only effective when consistently applied and supported by strong policies. The implication is that while interventions exist, their impact is limited by gaps in implementation, monitoring, and policy enforcement.

Strategies for Improving Ergonomic Safety (Research Question 5)

Findings from Table 5 showed strong agreement among respondents on strategies for addressing ergonomic hazards, with a grand mean of 4.24. Regular training (4.31), ergonomic assessments (4.26), provision of improved tools (4.23), and task rotation (4.21) were identified as key strategies.

This reflects a strong recognition of the need for proactive and structured interventions. The findings are consistent with recommendations by the Food and Agriculture Organization (2021), which highlighted training, technological improvement, and worker participation as essential components of sustainable agricultural practices. Similarly, the International Labour Organization (2022) advocated ergonomic design, continuous training, and workplace assessment as effective strategies to reduce occupational risks. The implication is that a comprehensive approach combining training, technology, and worker involvement is necessary to address ergonomic hazards effectively.

Discussion of Hypotheses

Hypothesis One (H_{01})

The null hypothesis was rejected, indicating a significant difference between farmers' and extension agents' responses regarding the prevalence of ergonomic hazards. This suggests that the two groups may differ in their level of exposure, experience, or professional knowledge. Extension agents, due to their technical backgrounds, may have a broader understanding of hazards than farmers.

Hypothesis Two (H_{02})

The null hypothesis was accepted, indicating no significant difference between farmers and extension agents regarding risky activities. This suggests a shared understanding of the tasks that pose ergonomic risks, likely due to direct involvement or observation of these activities.

Hypothesis Three (H_{03})

The null hypothesis was rejected, indicating a significant difference in perceptions of existing interventions. This may be due to differences in awareness, access to training, or involvement in policy implementation between farmers and extension agents.

Summary of Findings

The study reveals that ergonomic hazards are widespread in agrochemical application in Imo State, with significant health risks for agricultural workers. Although awareness exists, gaps in training, implementation, and policy support limit effective hazard control. Therefore, a

coordinated effort involving government agencies, extension services, and agricultural stakeholders is essential to promote ergonomic safety and sustainable agricultural practices. This study examined the ergonomic hazards associated with the application of agrochemicals among agricultural workers in Imo State, Nigeria, with an emphasis on prevalence, risk-prone activities, workers' perceptions, the effectiveness of existing interventions, and strategies to improve safety practices.

Five research questions and three hypotheses guided the study. A descriptive survey research design was adopted, and data were collected from agricultural workers and extension agents using a structured questionnaire. The collected data were analyzed using the mean and standard deviation to address the research questions. In contrast, Analysis of Variance (ANOVA) was used to test the hypotheses at a 0.05 level of significance.

The findings of the study revealed that:

1. Ergonomic hazards are highly prevalent among agricultural workers during agrochemical application. The most common hazards include musculoskeletal disorders such as back and joint pains, chemical poisoning, reproductive toxicity, and risks of male sterility.
2. Manual spraying, mixing and loading of chemicals, and operating farm equipment were identified as the most hazardous activities that expose workers to ergonomic strain and injury.
3. Although workers showed general awareness of ergonomic hazards, they lacked detailed knowledge of specific risks and preventive practices. Training on ergonomic safety was inadequate, and adherence to safety practices was inconsistent.
4. Existing ergonomic interventions such as training programmes and the use of personal protective equipment (PPE) were perceived as fairly effective; however, their implementation remains inconsistent and insufficient.
5. Respondents strongly supported strategies such as regular training, ergonomic assessments, improved tools, task rotation, and worker involvement as effective means of reducing ergonomic hazards.

The hypotheses tested showed that:

- i. There was a significant difference between farmers and extension agents on the prevalence of ergonomic hazards.
- ii. There was no significant difference between the two groups regarding risky agrochemical application activities.
- iii. There was a significant difference in their perceptions of existing ergonomic interventions.

Conclusion

Based on the findings of this study, ergonomic hazards are widespread among agricultural workers in Imo State, particularly during agrochemical application. These hazards pose serious risks to workers' health, safety, and productivity, and if not properly addressed, may lead to long-term occupational health challenges. Existing interventions, though beneficial,

are not adequately implemented or sustained, thereby limiting their effectiveness. Moreover, the persistence of hazardous work practices, such as manual spraying and improper agrochemical handling, underscores the need for improved ergonomic design, mechanization, and structured safety systems in the agricultural sector. Overall, the study establishes that improving ergonomic practices in agriculture is essential to enhancing workers' well-being, increasing productivity, and promoting sustainable agricultural development in Imo State and across Nigeria.

Recommendations

Based on the findings, the following recommendations are made:

1. Provision of Regular Training Programmes. Government agencies, extension services, and agricultural organizations should organize ongoing training programmes to educate farmers on ergonomic principles, safe agrochemical handling, and injury-prevention strategies.
2. Promotion and Enforcement of Personal Protective Equipment (PPE) Agricultural workers should be encouraged and supported to use appropriate PPE such as gloves, masks, boots, and protective clothing. Policies should be enforced to ensure compliance.
3. Introduction of Ergonomically Designed Tools and Equipment. Stakeholders should facilitate access to improved and ergonomically designed farm tools and technologies, such as mechanized sprayers and lightweight equipment, to reduce physical strain.
4. Strengthening Agricultural Extension Services. Extension agents should intensify awareness campaigns and provide farmers with hands-on guidance on safe work practices and ergonomic risk management.

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