



Bioscene

Bioscene

Volume- 21 Number- 04

ISSN: 1539-2422 (P) 2055-1583 (O)

www.explorebioscene.com

Assessing Drudgery Dynamics among Rice Farmers and Marketers in Southeast Nigeria: An Empirical Investigation

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Abstract: The study analysed the ergonomic impact of agricultural drudgery among rice farmers and marketers in Southeast Nigeria. The specific objectives were to ascertain the level of awareness of the ergonomic impact of drudgery on rice farmers and marketers, identify drudgery-causing activities, determine the types of drudgery experienced, and estimate the level of drudgery in rice farming and marketing. A multi-stage random sampling technique was employed to select 487 participants, comprising 221 rice farmers and 266 rice marketers. Data were collected through a survey using a well-structured questionnaire and analysed using bar graphs, the human physical drudgery index, body part discomfort, and postural analysis. Based on the drudgery index in rice farming, maintenance of equipment had a mean drudgery score of 0.48 and a residual capacity index of 0.52. Loading and unloading bags of rice had a mean drudgery score of 0.58 with a residual capacity index of 0.42. Transporting rice showed a mean drudgery score of 0.57 and a residual capacity index of 0.43. Setting up stalls or displays had a higher mean drudgery score of 0.62 with a residual capacity index of 0.38. Packaging and labelling shared the same mean drudgery score of 0.62 with a residual capacity index of 0.38. Interacting with customers had the highest mean drudgery score at 0.88 with a residual capacity index of 0.12. The mean marketing task performance index showed an average drudgery score of 0.63. Similarly, for rice marketers, maintenance of equipment had a mean drudgery score of 0.48 and a residual capacity index of 0.52. Loading and unloading bags of rice had a mean drudgery score of 0.58 with a residual capacity index of 0.42. Transporting rice showed a mean drudgery score of 0.57 and a residual capacity index of 0.43. Setting up stalls or displays had a higher mean drudgery score of 0.62 with a residual capacity index of 0.38. Packaging and labelling had a mean drudgery score of 0.62 with a residual capacity index of 0.38. Interacting with customers had the highest mean drudgery score at 0.88 with a residual capacity index of 0.12. The mean marketing task performance index showed an average drudgery score of 0.63. Maintenance of equipment had a difficulty score mean of 0.53. Loading and unloading bags of rice had a mean of

0.48. Transporting rice had a higher difficulty score mean of 0.75. Setting up stalls or displays had an even higher difficulty score mean of 0.80. Packaging and labelling had a mean difficulty score of 0.65. Interacting with customers had the lowest difficulty score mean of 0.41. The mean difficulty score was 0.60. The study recommended that the Federal Government agricultural departments and agencies should enhance ergonomic training for rice farmers and marketers.

Keyword: Ergonomics, Awareness, Drudgery, Rice Farmers, Rice Marketers

Introduction

Agriculture in sub-Saharan Africa (SSA) is drudgery prone due to a lack of improved agricultural technology. A larger proportion of agricultural tasks is physical due to the manual nature of the cultivation tasks (Neubert, Kaber, Phimphasak, & Puntumetakul, 2014; Swangnetr et al., 2014). Agriculture is one of the highly hazardous occupations globally (ILO, 2015; Cremasco et al., 2019), and depends primarily on manual labour (Mukherjee, 2014; Gupta & Gupta, 2019). Farmers use their bare hands to handle crude implements which are usually prone to uncomfortable posture, repetitive movements for a long time, forceful exertions and over extension (Naik & Khan, 2020). Farming is a challenging profession in which farmers suffer musculoskeletal disorders and other various work-related problems due to repeating manual tasks and stooped posture (Fathallah, 2010; Jain, Meena, Dangayach, & Bhardwaj, 2018). Research has shown that farming operations such as weeding, harvesting crops, marketing of agricultural produces etc generate excess physical strains on the skeletal system of farmers leading to musculoskeletal disorders (Das & Gangopadhyay, 2011; Das, 2015; Jain et al., 2018). Musculoskeletal disorders are the common work-related health problem affecting billions of people globally (Chang, Wu, Liu, & Hsu, 2012; Lei, Dempsey, Xu, Ge & Liang, 2015).

Globally, agriculture is the most important sector after the service sector in terms of employment (Gómez-Galán, Pérez-Alonso, Callejón-Ferre, & Sánchez-Hermosilla-López, 2018). In Nigeria, agriculture provides two-thirds of the nation's labour force (FAO, 2020). Agriculture in the country is dominated by smallholder farmers who use crude implements that require a high level of energy to operate. This results in physical and mental disorders in farmers. The average Nigeria smallholder farmers do not have good knowledge of this work-related health problem. They usually neglect their health conditions, view pain as a normal thing and only seek health care when the condition is disabling or severe. Agricultural output depends on the health status of the farmer, thus the health of the farmers is vital among the important agricultural development resources (Sundhesha, Santosh, & Surabhi, 2018).

Rice farming/production including marketing is one of the important agricultural activities in Nigeria. Rice farming involves many operations,

including preparation of field, making seedlings, nursing the seedling, planting and harvesting which result in musculoskeletal disorders (MSDs) such as wrist disorders and hand and back pains (Kar & Dhara 2007; Fathallah 2010; Kirkhorn, Earle-Richardson & Banks, 2010; Manida Swangnetr, Kaber, Puntumetakul, & Gross, 2014). Rice farming requires huge energy from farmers especially land preparation (Mamansari&Salokhe, 1995). Some Nigerian rice farmers still practice the traditional method of threshing by beating paddy on wood, manual parboiling, milling and portage of milled rice to markets, which result in drudgery to rice farmers and marketers, which may have ergonomic consequences.

Ergonomics (or human factors) is defined as the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (International Ergonomics Association (IEA), 2000). It is also defined as designing workstations, work practices and workflow to fit the employees' capabilities (Occupational Safety and Health Academy (2017). It is the art and science of fitting the work to the person (farmers) and designed to ease the task of farmers by using appropriate equipment, a conducive working environment and knowledge that suit each worker (Rajendran and Reddy, 2013; Sharma, Verma, Pandey, & Patidar, 2018). Drudgery generally involves physical and mental strain, monitoring hardship and fatigue (Thakur, Varma, & Goldey, 2001). Drudgery in agriculture reduces farmers' work capacity which in turn may lower the contribution of the agricultural sector to the economy of a nation, especially in developing nations (Gadhavi & Shukla, 2019).

Past studies on ergonomics in Nigeria focused largely on industrial sector and academic environments; works such as Oladeinde et al., (2015) who assessed the knowledge of ergonomics among medical laboratory scientists in Nigeria; Omoneye, (2016) examined the ergonomic hazards which are associated with auditors' job performance in Nigeria, Momodu & Edosomwa, (2014) evaluated ergonomic deficiencies in Nigeria computer workstation. Sadiq et al., (2022) who determined the labour efficiency of rice farmers in Nigeria's North-central region and Toyin et al., (2021) who examined the prevalence and exposure to ergonomic risk factors among crop farmers in selected states in Nigeria. Studies that focused on ergonomics of the farming community which constitute over 70 percent of the workforce in Nigeria is scanty (Mgbenka & Mbah, 2016). Thus, there is a great need to assess the ergonomic impact of agricultural drudgery and the health-seeking behaviours amongst rice farmers and marketers in Southeast Nigeria to reduce the drudgery of farmers. This study is therefore poised to bridge this knowledge gap. This study intends to answer the following research questions:

- i. what is the level of drudgery experienced in rice farming and marketing?

Objectives of the Study

The broad objective of this study is to analyse the ergonomic impact of agricultural drudgery amongst rice farmers and marketers in Southeast, Nigeria. The specific objectives include to:

- i. estimate the level of drudgery experienced in rice farming and marketing;

Research Methodology

The study area for this research work is Southeast, Nigeria.

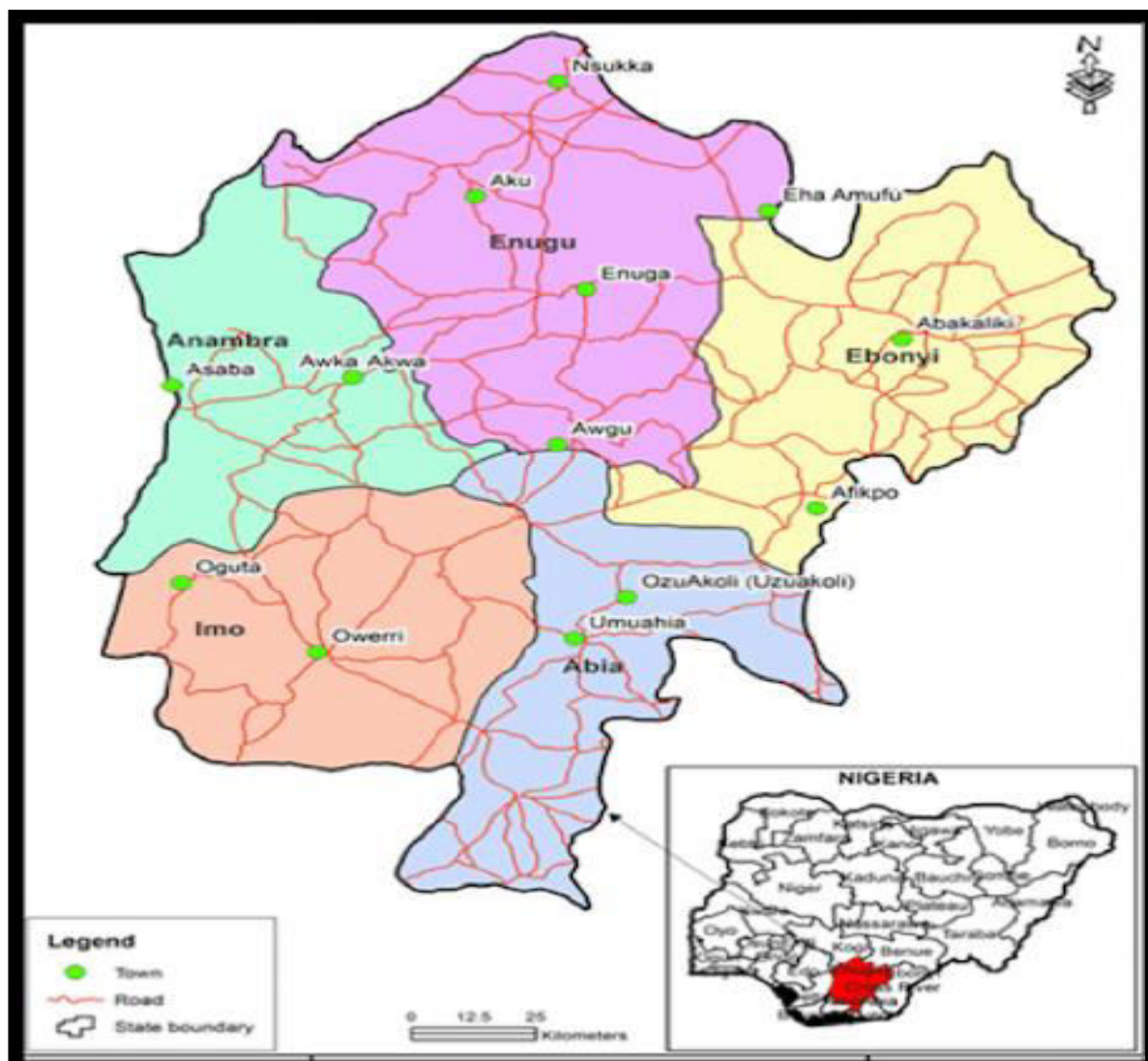


Figure 3.1: Map of South east. Source: Onu (2020).

3.2 Sampling Technique

A multi stage random sampling technique was used in the selection of 487 rice farmers and markets (i.e. 221 rice farmers and 226 rice marketers) in the study area. Data for the study were collected through a survey with the use of a well-structured questionnaire. Data for the study were analysed through the application of both descriptive such as Likert scale rating technique, Human physical drudgery index and Body part discomfort and postural analysis.

Human Physical Drudgery Index (Objective iii)

Following Ruplekha and Kalita (1998) and Joshi et al. (2015), Human Physical Drudgery Index (HPDI) was used to examine the drudgery level of rice farmers (objective iv). Human Physical Drudgery Index of rice farming activity: HPDI were calculated based on a linear combination method using the scores obtained from Time spend on rice farming activities, postural discomfort, load/force, frequency of postural change, body posture adopted, difficulty score of the activity and task performance score.

Step 1 (A_i): Time spent (hours per year) = Time in hours per day multiplied by the total number of days performed in a year.

Step 2 (B_i): Task performance score = Daily (5), Alternate days (4), Weekly (3), Fortnightly (2) and seasonally (1).

Step 3 (C_i): Difficulty score of activity = Most difficult (5), difficult (4), neutral (3), easy (2) and very easy (1).

Step 4 (D_i): Body posture adopted = Upright (1), trunk flexion/extension 0-200 (2), trunk flexion/extension >200 (3), trunk flexion >600 (4) (Additional scores if repetition of activity +1, one or more body parts are static for longer than 1 min +1, squatting/stooping +1, back twisted +1).

Step 5 (E_i): Frequency of Postural change (number of times posture changes) = 1-3 times (1), 4-6 times (2), 7-9 times (3) and >9 times (4).

Step 6 (F_i): Postural discomfort (pain/tingling/numbness etc. in body parts) = Very severe (5), Severe (4), Moderate (3), Light (2) and Very Light (1).

Step 7 (G_i): Load/force = 0-5kg (1), 5-10kg (2), 10-15kg (3), 15-20kg (4), >20kg (5)

The formula for Calculating HPDI:

$$HPDI = \frac{A_i + B_i + C_i + D_i + E_i + F_i + G_i}{7} \times 100$$

Body Part Discomfort (BPD) Scale

Following Das and Gangopadhyay (2011); Swangnetr et al. (2014), the Body Part Discomfort Scale were used to assess the ergonomic and occupational health-related problems among rice farmers (objective iv). This involves identifying the level of discomfort in their different body parts. It is a ten (10) point scale for discomfort and pain sensation. A score of 1 represents little pain, 5 represents moderate pain and 10 represents intolerable pain (Fig. 2).

Postural analysis

The Rapid Entire Body Assessment (REBA) method were applied for postural analysis of work-related musculoskeletal risk factors. REBA (Rapid Entire Body Assessment) was developed by Hi-gnett and McAtamney (2000) to provide a quick and easy observation postural analysis tool for whole-body activities (static and dynamic giving musculoskeletal risk action level).

Results and Discussion

Index of Drudgery in Rice Farming and Marketing

Index of Drudgery in Rice Farming

The result on Table 3 provides a thorough and quantified assessment of the drudgery associated with various rice farming tasks. Tasks like weeding and harvesting are identified as particularly strenuous, while tasks like watering are less demanding. The difficulty scores and postural change indices highlight the physical demands and ergonomic challenges faced by rice farmers. The residual capacity index adds another layer of understanding, showing how much of the worker's capacity remains available after accounting for the effort put into each task. This comprehensive analysis offers valuable insights for potential interventions to reduce the drudgery in rice farming, making it more sustainable for farmers. The linear combination is the sum of the farm task performance score, the difficulty score, and the postural change index, which together give the drudgery index. This comprehensive analysis helps in understanding the physical demands and ergonomic challenges faced by rice farmers.

Weeding has the highest mean drudgery score at 0.89, indicating it is an extremely labor-intensive task. The residual capacity index for weeding is 0.11, suggesting that only 11% of the worker's capacity is available for other tasks or for sustaining the current task without significant strain. This low residual capacity highlights the exhausting nature of weeding. Bush Clearing shows a mean drudgery score of 0.66 with a residual capacity index of 0.34. This indicates a moderate level of drudgery, where 34% of the worker's capacity remains unutilized. This higher residual capacity compared to weeding implies that bush clearing, while still demanding, leaves more room for the worker's endurance. Pruning/Mulching has a mean drudgery score of 0.68 and a residual capacity index of 0.32. This task is moderately demanding, and the residual

capacity suggests that 32% of the worker's capacity remains unexhausted, allowing for better sustainability in the long term. Harvesting presents a lower mean drudgery score of 0.55 with a residual capacity index of 0.45, indicating it is less strenuous compared to other tasks like weeding. The residual capacity indicates that 45% of the worker's capacity is available, reflecting a relatively lower physical toll.

Table 3: Index of Drudgery in Rice Farming

For Rice Farmers Farm task performance	Mean Drudgery score	Residual capacity index	Linear Combination	Drudgery index
Weeding	0.89	0.11		
Bush clearing	0.66	0.34		
Pruning/mulching	0.68	0.32		
Harvesting	0.55	0.45		
Fertilizer application	0.56	0.44		
Watering	0.56	0.44		
Mean farm task performance	0.65	0.35	0.65	
Difficulty score of farm activity				
Weeding	0.52	0.48		
Bush clearing	0.48	0.52		
Pruning/ Mulching	0.73	0.27		
Harvesting	0.84	0.16		
Fertilizer application	0.67	0.33		
Watering	0.37	0.63		
Mean Difficulty Score	0.60	0.4	0.60	
Postural change Index				
Body posture adopted	0.76	0.24		
Frequency of postural change	0.69	0.31		
Postural discomfort	0.58	0.42		
Load/force	0.52	0.48		
Mean Postural change index	0.64	0.36	0.64	0.63

Source: Field Survey (2023).

Fertilizer application has a mean drudgery score of 0.56 and a residual capacity index of 0.44. This shows that the task is moderately demanding, and a significant portion of the worker's capacity (44%) remains unutilized, making it more sustainable over time. Watering shares the same mean drudgery score of 0.56 with a residual capacity index of 0.44, similar to fertilizer application. This indicates that watering is also less demanding, with a significant portion of the

worker's capacity (21%) remaining available. The mean farm task performance shows an average drudgery score of 0.65 with a residual capacity index of 0.35. This suggests that on average, rice farming tasks are moderately demanding, with 35% of the worker's capacity remaining available for other activities or for sustaining current tasks without significant strain.

The difficulty score provides further insights into the physical demands of each task. Weeding has a difficulty score mean of 0.52, indicating it is moderately difficult. Bush Clearing follows with a mean of 0.48. Pruning/Mulching has a higher difficulty score mean of 0.73, while harvesting tops the difficulty scores with a mean of 0.84, reflecting significant physical demands. Fertilizer application has a mean difficulty score of 0.67, and watering has the lowest difficulty score mean of 0.37. The Mean difficulty score is 0.60, indicating that on average, the tasks are moderately difficult.

The Postural change index measures ergonomic factors such as body posture, frequency of postural changes, postural discomfort, and load/force. Body Posture adopted has a mean index of 0.76, indicating that many tasks require uncomfortable or strenuous body positions. Frequency of Postural Change has a mean of 0.69, suggesting frequent changes in posture contribute to physical strain. Postural Discomfort has a mean of 0.58, reflecting moderate levels of discomfort. Load/Force is lower, with a mean of 0.52, indicating moderate physical exertion. The mean postural change index is 0.64, indicating moderate ergonomic impact overall. The Drudgery Index is derived from the linear combination of the farm task performance score, the difficulty score, and the postural change index. This comprehensive measure provides an overall indication of the physical demands and strain associated with each task. The mean drudgery index is calculated to be 0.65, suggesting that, on average, rice farming tasks are moderately demanding/difficult. These findings affirm Gadhavi and Shukla, (2019) who reported that rice farming activities such as planting, weeding, transplanting, harvesting including postharvest activities are associated with drudgery and are time-consuming. This finding however, contrasts Singh et al., (2006) who reported maximum drudgery in rice farming to be associated more with rice-transplanting and harvesting activities and that harvesting of rice is a drudgery-induced task for it leads to backache as the labourer has to bend upon the crop and to move forward while cutting the plants with sickle. Oberoi and Singh (2001) also identified harvesting and marketing operation as the most prone rice farming tasks associated with drudgery since harvesting is normally carried out in squatting/bending postures with a relatively high workload. These findings contradict Nguyen et al., (2013) who were of the opinion that farm tasks such as weeding, bush clearing, and harvesting often involve repetitive and strenuous physical activities which can lead to musculoskeletal problems, fatigue, and long-term health issues among rice farmers.

Index of Drudgery in Rice marketing

The result on Table 4 offers a thorough and quantified assessment of the drudgery associated with various rice marketing tasks. Tasks like interacting with customers and setting up stalls or displays are identified as particularly strenuous, while tasks like equipment maintenance are less demanding. The difficulty scores and postural change indices provide deeper insights into the physical demands and ergonomic challenges faced by rice marketers. The residual capacity index adds another layer of understanding, showing how much of the worker's capacity remains available after accounting for the effort put into each task. This comprehensive analysis offers valuable insights for improving work conditions and implementing effective interventions to enhance the sustainability and well-being of rice marketers. This table includes measures such as the drudgery score, residual capacity index, and a linear combination to derive an overall drudgery index, offering insights into the physical demands and ergonomic challenges faced by rice marketers.

Table 4: Index of Drudgery in Rice marketing

Rice Marketers Marketing task performance	Mean Drudgery score	Residual capacity index	Linear Combination	Drudgery index
Maintenance of equipment	0.48	0.52		
Loading and unloading bags of rice	0.58	0.42		
Transporting rice	0.57	0.43		
Setting up stalls or displays	0.62	0.38		
Packaging and labelling	0.62	0.38		
Interacting with customers	0.88	0.12		
Mean marketing task performance index	0.63		0.63	
Difficulty score of farm activity				
Maintenance of equipment	0.53	0.47		
Loading and unloading bags of rice	0.48	0.52		
Transporting rice	0.75	0.25		
Setting up stalls or displays	0.80	0.2		
Packaging and labelling	0.65	0.35		
Interacting with customers	0.41	0.59		
Mean Difficulty Score	0.60	0.4	0.60	
Postural change Index				
Body posture adopted	0.70	0.3		

Frequency of postural change	0.68	0.32		
Postural discomfort	0.61	0.39		
Load/force	0.30	0.7		
Mean Postural change index	0.57	0.42	0.57	0.60

Source: Field Survey (2023).

Maintenance of equipment has a mean drudgery score of 0.48, indicating it is a moderately labor-intensive task. The residual capacity index for this task is 0.52, suggesting that 52% of the worker's capacity is available for other tasks or for sustaining the current task without significant strain. This higher residual capacity reflects a relatively lower physical toll. Loading and unloading bags of rice shows a mean drudgery score of 0.58 with a residual capacity index of 0.42. This indicates a higher level of drudgery compared to equipment maintenance, with 42% of the worker's capacity remaining unutilized, implying a more demanding nature. Transporting rice has a mean drudgery score of 0.57 and a residual capacity index of 0.43. This task is moderately demanding, and the residual capacity suggests that 43% of the worker's capacity remains unexhausted, allowing for better sustainability in the long term. Setting up stalls or displays presents a higher mean drudgery score of 0.62 with a residual capacity index of 0.38, indicating it is more strenuous compared to tasks like equipment maintenance. The residual capacity indicates that 38% of the worker's capacity is available, reflecting a relatively higher physical toll.

Packaging and labelling shares the same mean drudgery score of 0.62 with a residual capacity index of 0.38. This shows that the task is moderately demanding, and a significant portion of the worker's capacity (38%) remains unutilized, making it more sustainable over time. Interacting with customers has the highest mean drudgery score at 0.88, indicating it is a highly labor-intensive task. The residual capacity index for interacting with customers is 0.12, suggesting that only 12% of the worker's capacity is available for other tasks or for sustaining the current task without significant strain. This low residual capacity highlights the exhausting nature of customer interaction. The mean marketing task performance Index shows an average drudgery score of 0.63, suggesting that on average, rice marketing tasks are moderately demanding, with the residual capacity index not specified but assumed to be inversely related to the drudgery score.

The difficulty score provides further insights into the physical demands of each task. maintenance of equipment has a difficulty score mean of 0.53, indicating it is moderately difficult. Loading and unloading bags of rice follows with a mean of 0.48. Transporting Rice has a higher difficulty score mean of 0.75, while setting up stalls or displays has an even higher difficulty score mean of 0.80, reflecting significant physical demands. Packaging and Labelling has a mean difficulty score of 0.65, and Interacting with Customers has the lowest difficulty score mean of 0.41. The mean difficulty score is 0.60, indicating that on

average, the tasks are moderately difficult. The Postural Change Index measures ergonomic factors such as body posture, frequency of postural changes, postural discomfort, and load/force.

Body posture adopted has a mean index of 0.70, indicating that many tasks require uncomfortable or strenuous body positions. Frequency of Postural Change has a mean of 0.68, suggesting frequent changes in posture contribute to physical strain. Postural Discomfort has a mean of 0.61, reflecting moderate levels of discomfort. Load/Force is lower, with a mean of 0.30, indicating lower physical exertion but possibly higher discomfort due to posture and frequency of changes. The mean postural change Index is 0.57, indicating moderate ergonomic impact overall. The Drudgery Index is derived from the linear combination of the marketing task performance score, the difficulty score, and the postural change index. This comprehensive measure provides an overall indication of the physical demands and strain associated with each task. The mean drudgery index is calculated to be 0.63, suggesting that, on average, rice marketing tasks are moderately demanding/difficult.

According to Deanhanger, (2010) interacting with customers can be demanding and stressful, especially during peak times or when dealing with difficult or dissatisfied customers. This can lead to increased pressure, emotional strain, and potential burnout for rice marketers.

Setting up stalls or displays parameter has the highest difficulty score of mean 0.80 indicating it as a challenging aspect of marketing. This is true since setting up stalls or displays often involves physical labour, including lifting, arranging, and organizing merchandise. This can be repetitive and physically demanding, contributing to a sense of drudgery, especially if the tasks are monotonous (Worksafe, 2010). Interacting with customers has the lowest difficulty score of 0.41, suggesting it as a relatively easier task for rice marketers in the study area. The mean difficulty score of 0.60 is moderate high, indicating a less balanced level of difficulty across rice marketing activities in the study area. Frequency of postural change as well as postural discomfort with a mean score of 0.70 and 0.68 respectively were the postural change parameters with the highest reported postural change index, while load/force with a mean of 0.30 had the lowest impact on the postural changes of rice marketers in the study area. Rice marketing activities involve tasks that require prolonged periods of standing, lifting, or carrying heavy loads. Hardke and Sadaka, (2013) in their findings, revealed that workers who are consistently exposed to prolonged periods of standing without adequate opportunities for postural change may experience physical strain and discomfort, contributing to a sense of drudgery. From the findings suggest that rice farmers (0.63) experienced slightly higher average drudgery indices compared to rice marketers (0.60), indicating that the physical and task-related challenges are more demanding in rice farming than in rice marketing but in a relative sense.

Conclusion and Recommendations

The study concludes that ergonomic drudgery significantly impacts rice farmers and marketers in Southeast Nigeria. Rice farmers experience significant drudgery primarily from activities such as animal husbandry, pest application, and equipment maintenance. Similarly, rice marketers face considerable strain from packaging, labelling, and interacting with customers. Based on the study's findings, the following recommendations are made:

- i. Government agricultural departments and agencies should enhance ergonomic training for rice farmers and marketers. This recommendation is based on the finding that, although there is high awareness of symptoms and the benefits of stretching, knowledge about ergonomic tools and risk factors is limited.
- ii. Agricultural cooperatives and industry associations should invest in ergonomic equipment and tools. This is recommended due to the identified drudgery-inducing activities, such as packaging and labelling for marketers and animal husbandry and pest application for farmers, which contribute to significant physical strain.
- iii. Farm and market operators should promote regular breaks and stretching exercises. This recommendation is driven by the study's findings that prolonged work periods and awkward postures contribute to physical discomfort and potential musculoskeletal issues.
- iv. Healthcare providers and local health authorities should strengthen health support services. This is prompted by the study's observation of musculoskeletal problems, mental health concerns, and the need for accessible health screenings and physical therapy.
- v. Community organisations and local NGOs should foster community support and social integration. This recommendation arises from the reported feelings of isolation and lack of social support, which negatively impact the mental well-being of rice farmers and marketers.

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