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Multinomial Logistic Regression to Access Post-Harvest Losses of Rice in Some Parts of Benue State, Nigeria

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ABSTRACT:

This research explores the relationship between effective communication and post-harvest losses among rice farmers in two Local Government Areas (LGAs) of Benue State, Nigeria—Agatu and Gwer-west. The study focuses on the demographics of rice farmers, communication preferences, and the estimation of post-harvest losses along the rice value chain. A quantitative research design employing a multiple logistic regression model is utilized to quantify the associations between variables. Data collection involves a well-structured questionnaire covering demographics, effective communication, and post-harvest losses. The sampling technique is a multi-stage random sampling method, with 600 farming households selected from the two LGAs. Data pre-processing includes handling missing data, detecting outliers, and variable transformations. The statistical analysis employs a multiple logistic regression model to estimate the data, utilizing SPSS software. Hypothesis testing is conducted to determine the significance of independent variables on post-harvest losses. Ethical considerations are strictly adhered to, ensuring confidentiality and obtaining informed consent. Demographic analysis reveals that a majority of farmers are youths, and gender distribution is relatively equal. Communication analysis indicates a preference for direct contact, with 78% of farmers perceiving communication as effective. Post-harvest loss regression analysis demonstrates that 90.2% of farmers experience low losses (less than 25% of harvested produce). The statistical models show significant variations, and the pseudo R-squared indicates a reasonable predictive accuracy. Conclusion highlights the inverse effect of effective communication on reducing post-harvest losses, supporting existing literature. However, age and farming experience exhibit more significant influences. Recommendations include enhancing storage facilities, adopting modern drying techniques, implementing quality packaging, and strengthening transportation infrastructure. Additional recommendations suggest market linkages, crop insurance, community-based storage initiatives, ICT solutions, diversification of rice varieties, training on quality control standards, waste utilization programs, and consumer awareness campaigns. These comprehensive measures aim to address the multifaceted challenges associated with post-harvest management in rice production.

Keywords: Post-harvest losses, rice value chain, agricultural communication, Benue State, multinomial logistic regression, food security.

INTRODUCTION

The need for increasing food demand is being heightened by factors such as increased rate of urbanization, climate change, and use of land for non-agricultural purposes (Kumar and Kalita, 2017). Amidst all these issues, post-harvest loss is one critical issue that has received not more than 5% research funds (Kumar and Kalita, 2017; Kitinoja *et al.*, 2011). There are several stages at which food losses occur. These include production, post-harvest and processing (Parfitt *et al.*, 2010). The distribution of losses across the value chain in developed economies differs from that in developing and under developed economies (Bamikole *et al.*, 2022).

Nigeria is one of the developing nations facing the problem of food insecurity. As such, there are policies put in place to enhance agricultural production in Nigeria. The agricultural sector is one of the major employers of labour in Nigeria, in addition to the oil and gas sector, including solid minerals (Abbas *et al.*, 2018). Agriculture contributes significantly to the Gross Domestic Product (GDP) of Nigeria (Abbas *et al.*, 2018). Hence, it remains an important sector of the Nigerian economy. GDP from Agriculture is 5,568,554.89 NGN Million as at Mar 2023. The types of crops grown in different parts of Nigeria depend on the varying geographical conditions across the country (Abbas *et al.*, 2018). These variations in geographical locations in terms of climatic factors account for the reason some regions cultivate more of certain crops than other regions of the country. Despite the diverse climatic conditions in Nigeria that support the production of different agricultural products, most of the agricultural products are lost at the post-harvest stage (Olayemi *et al.*, 2012). The post-harvest processing technologies adopted by most farmers for different crops in Nigeria are traditional methods that cannot mitigate the spoilage of foods and loss in the nutritional value of such foods (Elemasho *et al.*, 2021; Olayemi *et al.*, 2012; Oni & Obiakor, 2002). Regardless of the types of crops being cultivated in different regions of the country, there are common problems of post-harvest loss.

One of the major staples in Nigeria is rice. Nigeria is the largest consumer of rice in West Africa due to her high population density. The country's estimated annual demand for milled rice is 5.2 million tonnes, while the average national production is 3.0 million tonnes (Oguntade *et al.*, 2014).

According to (USAID, 2013), Nigeria consumes 5.4 million metric tonnes of rice annually, of this value, annual domestic output of rice still hovers around 3.0 million metric tonnes leaving the huge gap of about 2.0 million metric tons to importation. An estimated supply and demand gap of about 2.0 million tonnes can only be bridged by importing rice. Nigeria's rice processing capacity is 2.8 million tonnes of paddy (Jica, 2013). Over the years Nigeria has attempted to increase local rice production with a view to reducing imports. It has used various tariff and levy regimes as well as imposing restrictions to discourage imports and encourage local production. Currently there is 10% import tax and 100% levy on the import of semi-milled or wholly milled rice (Federal Ministry of Finance, 2014). One of the agricultural goals of the Nigerian government is self-sufficiency in rice production and the complete cessation of rice imports (Oguntade *et al.,* 2014).

Communication plays a crucial role in mitigating post-harvest loss of rice products. By maintaining clear and open lines of communication between farmers, distributors, and storage facilities, potential issues such as delays in transportation, inadequate storage conditions, or improper handling can be identified and addressed promptly. Moreover, communication can also facilitate the sharing of best practices and knowledge on post-harvest handling techniques, storage methods, and quality control measures among stakeholders in the rice supply chain. This exchange of information can lead to improved efficiency, reduced losses, and ultimately, increased

MATERIALS AND METHODS

Location of Study

The entire research study was carried out in two (2) Local Government Areas in Benue state, Nigeria. They are Agatu, with a Latitude of 7.9°N and a Longitude of 8.0°E. and Gwer-west Latitude of 7.6°N and a Longitude of 8.2°E. Benue is one of the states in the North-central geopolitical zones of Nigeria. Benue has coordinates of Latitude 7.3°N and Longitude 8.5°E. The last population census carried out in 2006 shows that the population of Benue is about 4,253,641. Three major tribes exist in Benue: Tiv, Idoma, and Igede. Rice is grown in all the senatorial districts (Zone A, Zone B, and Zone C) of Benue State

Method of Data Collection

Data were collected using a well-structured questionnaire that entails information on demographics (age, gender and educational level) variables on rice farmers, effective communication, and estimates of Post-harvest losses associated with the rice value chain of rice farms.

Results

DEMOGRAPHIC ANALYSIS

The demographic analysis of farmers shows that most of the farmers are youths as majority lie below the ages of 55years accounting for 94% of the farmers, while 6% are above 56years.

However, 38% of the farmers lie between 46-55years which is closely followed 23.2% of those within the age group of 36-45years. See table 1.

Table 2., Shows that 58.3% of our farmers are male against 41.7% female farmers, accounting for a good ratio of gender equality.

A total of 27.2% of rice farmers had farming experience below 5years and 16.5% between 6-10years. 33.7% of farmers have rice farming experience between 11-15years while 22.7% had experience between 16-20%.

However, a cumulative of 43.7% of farmers had farming experience below 10years, while 56.3%

of rice farmers had experience of over 10years

Table 1. shows the statistical analysis of age groups of the farmers.

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	≤25	84	14.0	14.0	14.0
	26–35	110	18.3	18.3	32.3
	36–45	139	23.2	23.2	55.5
	46–55	231	38.5	38.5	94.0
	≥56	36	6.0	6.0	100.0
	Total	600	100.0	100.0	

5.1.2 COMMUNICATION ANALYSIS

Most rice farmers surveyed indicated their preference of communication by direct contact, this accounted for 53.3% of farmers studied. A total of 6.5% preferred different media methods as compared to 40.2% of rice farmers preferred both direct contact and different media methods.

A total of 78% cumulative percentile of the farming population indicated that the communication was effective. However, 14.2% indicated that it was fair while a cumulative percentile of 7.8% indicated that it was poor.

Table 5: Best Practices in Receiving Information

Receiving Information model		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	By direct contact	320	53.3	53.3	53.3
	Different media methods	39	6.5	6.5	59.8
	All of the above	241	40.2	40.2	100.0
	Total	600	100.0	100.0	

5.1.3 POSTHARVEST LOSS REGRESION ANALYSIS

Table 8., shows that a cumulative percentage of 48.5% of farmers harvested 15 basins of rice or less, while a cumulative percentage of 51.5% harvested 16 basins of rice and above. However, 41.2% of the farming population under study harvested 21 basins of rice and above. The result of postharvest losses from this study showed that all farmers had postharvest loss. However, 90.2% had low postharvest loss of less than 25% of harvested farm produce compered to higher losses above 25% of harvested produce, making a cumulative percentile of 9.8%. See table 9.

Table 10., show that data analyzed for this study was fit for the proposed prediction, as the level of significant $p<0.5$ with a Chi-square value of 106.916. This is also affirmed from by table 11., which showed level above $p>0.05$. this means that the independent variable showed significant variation.

The pseudo R-squared in Table 12., shows that 31.2% of the information was accurately predicted by the independent variables using Nagelkerke reading reflecting a reasonable size.

The likelihood test in table 13., shows that data on communication had more effect on the predictions at significant level of $p<0.5$. as compared to other parameters such as farming experience, age, gender and best communication practice.

Table 14., shows that farmers between the ages of 25-35years and between 45-55years showed significant levels of $p<0.05$ on effect of communication to low postharvest losses. This also showed that that farmers between 36-45years are more likely to experience low postharvest losses than those below 25years and above 45years with a ratio of 40026.831 against 33553.873 (see table 5). This is equally reflected in years of farming as experiences showed an inverse relation to low postharvest losses given a negative figure of -15.489 although these were not significant at $p<0.5$.

The parameter estimations on table 5., shows that effective communication had an inverse relation to postharvest loss (-42,202, -3.083, -0.815) and farmers with forty experience and above showed similar inverse relationship (-15.841) to post harvest losses. However, they show no significant value at $p<0.05$

Effective communication was not significant at $p<0.05$. It however had an inverse relation to postharvest loss by a value of -42.202 to -0.815 for various categories of communication. This is also shown by figure 1., above.

Access to extension service showed no significance at $p<0.05$ but however it showed an inverse relationship to increase in quantity of postharvest loss at -0.468 in table 14. This is also seen in figure 2.

CONCLUSION

Africa Union Commission (2018) reported that the key challenges facing in postharvest loss including lack of: awareness and communication on consequences of postharvest losses.

This study indicates that effective communication showed an inverse effect on reducing postharvest losses (figure 1). This is in affirmation with African Union Commission, (2018). But may not have been the primary reason for reduced postharvest losses as age and experience showed a more significant value at $p<0.05$. Inferring that age and experience in farming are added values to reduced postharvest losses.

We also find that access to extension service reduced postharvest losses compared to farmers who did get these services. However, it will be advised that the frequency of this service be increased from annually, as this will help amend difficulties in farming practice face during the farming season.

In Ethiopia the Major challenges facing in postharvest handling include lack of: - awareness, communication, targeted policies and strategies, evidence-based postharvest loss assessments, institutional and organizational arrangements, targeted financing and investment in postharvest handling (Godebo, 2020).

According to Misrak et al., (2014). Postharvest losses can be minimized by appropriate and feasible agricultural techniques such as general principles of extending shelf life of crops must be put in place.

RECOMMENDATIONS

Based on the findings of this study on post-harvest challenges in rice production, the following actionable recommendations are proposed to mitigate these challenges:

1. **Enhance Storage Facilities**: Invest in improved storage facilities equipped with climate control mechanisms. This can help regulate temperature and humidity, minimizing losses due to mold, pests, and other environmental factors.
2. **Adopt Modern Drying Techniques:** Encourage the adoption of modern and efficient drying techniques to reduce moisture content in harvested rice. This step is crucial in preventing fungal growth and maintaining the quality of the crop during storage.
3. **Implement Quality Packaging:** Promote the use of high-quality packaging materials that provide adequate protection against moisture, pests, and physical damage during transportation and storage. This can significantly reduce losses during the post-harvest period. Strengthen Transportation Infrastructure: Invest in upgrading transportation infrastructure to ensure timely and safe delivery of harvested rice from farms to storage facilities and markets. Improving road networks and transportation systems can minimize transit times and reduce the risk of damage.
4. **Training and Education Programs:** Conduct training programs for farmers on best practices in post-harvest management. Educate them on proper harvesting techniques, storage practices, and the importance of timely transportation to enhance overall efficiency.
5. **Research and Development:** Allocate resources to research initiatives focused on developing new technologies and innovations in post-harvest management. This includes exploring advancements in storage methods, transportation technologies, and crop protection measures.
6. **Government Support and Policies:** Implement supportive policies and incentives at the governmental level to encourage investments in post-harvest infrastructure. Subsidies, grants, or low-interest loans can incentivize farmers and stakeholders to adopt improved post-harvest practices.
7. By combining all these recommendations with the outlined strategies, a comprehensive and integrated approach can be developed to tackle the multifaceted challenges associated with post-harvest management in rice production.

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