



LEVEL OF ADOPTION OF IMPROVED POST-HARVEST TECHNOLOGIES FOR RICE PROCESSING AMONG WOMEN RICE PROCESSORS IN NIGER STATE, NIGERIA

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ABSTRACT

The study examined the level of adoption of improved post-harvest technologies for rice processing among women rice processors in Niger State, Nigeria. Multi-stage purposive and random sampling procedures were adopted in selecting 424 women rice processors for the study. Data were collected through questionnaire and focus group discussion and analysed using frequency, percentage, mean, ranking and standard deviation. The mean ages and household sizes of the adopters and non-adopters were 36 and 41 years, and 6 to 7 persons per household, respectively. The results also revealed that majority (86% and 98%) had gone through different educational courses. Most (97% and 93%) and majority (86%) had mean scores of 2.925, 2.901, and 2.778 for using false bottom for rice steaming, packaging materials and rice mill technologies while 34% and 20% had primary school certificates, with a mean 9 and 7 years of rice processing experience and 5 and 3 years of membership in cooperative societies, respectively. A significant proportion of 64% and 50% received credits of ₦200000-299000 and ₦100000-199000, with mean values of ₦200605 and ₦92357.14. Additionally, mean scores of 3.156, 2.778, 2.925, and 2.901 were recorded for various technologies, indicating a high level of adoption. The results further revealed that experience in rice processing and household size were significant ($P < 0.01$) in influencing the level of adoption of IPHTRP. Also, contact with extension agents and access to market were significant ($P < 0.05$) in influencing the level of adoption of IPHTRP. However, several key issues: inadequate funding, perceived ineffectiveness of the technology, and low demand for processed rice, all of which hinder adoption. The Study concluded that experience in rice processing, household size, extension contact and access to the market were the significant factors influencing the level of adoption of IPHTRP. It also resulted in advanced skills, the drivers of rice processing quality, increased income, changes in spending habits, and reduced physical exertion of the women rice processors. The study recommends that both government and non-governmental organisations train women rice processors, ensure fair paddy prices, establish a stable market for processed rice, and provide ongoing support through extension agents.

Keywords: Adoption, Post-Harvest, Technologies, Rice, Processing, Women

INTRODUCTION

Agriculture plays a crucial role in Nigeria's economy, similar to other developing countries. According to Qu *et al.* (2021), developing countries suffer more food losses than food waste. The reduction in income due to food losses is a great threat to farm livelihoods in these countries that are already on the verge of food insecurity. Nigeria has an estimated population of over 237.8 million people (Worldometer, 2025) to feed, so the need for food security, sustainability and research on agricultural activities become vital. According to the Food and Agriculture Organization of the United Nations (FAO), food production will have to increase by 70% to feed the world's projected 9.1 billion population by 2050 (FAO, as cited in Qu *et al.*, 2021).

Rice production and processing account for over 40% of the gross domestic product (GDP) (National Bureau of Statistics [NBS], 2019). Rice is a vital food crop for Nigeria's economy. However, domestic production does not suffice to meet the growing demand, leading to substantial imports of over 2,000,000 metric tonnes each year (Organisation for Economic Co-operation and Development (OECD) and FAO, 2021). According to Uduma *et al.* (2016), the increasing demand for rice in Nigeria can be attributed in part to the growing population, rising income, rapid urbanization and



changes in family occupational structures. In Niger State, women play a vital role in the rice value chain, particularly in post-harvest processing (Danbaba *et al.*, 2019). According to Aminu and Ogunlade (2018), women rice processors are faced with challenges in accessing improved rice processing technology. Also, this has impacted their livelihoods, drudgery and time-consuming nature, traditional rice processing technologies do not offer significant improvement or efficiency in processing capacity, leading to reduced rice quality such as broken grains, impurities, and low grain integrity, exposure to dust, fumes, and stones. Additionally, this affects consumer acceptability and the women processors' income. Due to these problems, the efforts of the women rice processors were supported with a set of IPHT4RP such as rice parboilers, destoning sieves, stitching machines, weighing scales, drying slabs, rice mills, and packaging materials to enhance high-quality stone-free rice to serve both domestic and foreign markets (Danbaba *et al.*, 2013).

It was 'expected' that each group of women rice processors would use the equipment and continue to apply the technologies learned to produce better-quality rice to supply the domestic and foreign markets' demands. Aside from the equipment, special presidential committees on quality rice processing were set in motion to facilitate the training of women rice processors on the use of IPHTRP in their various communities to enhance the quality of rice processed locally (Federal Ministry of Agriculture and Rural Development (FMARD), 2016). Despite all these interventions, there was no significant change as expected in the quality of rice processed locally among these women rice processor groups in Niger State. There is scanty empirical evidence of the IPHT4RP impact on their livelihood. Also, the preference for imported rice did not stop (FMARD, 2016). Furthermore, no sufficient document on the level of adoption of the IPHTRP disseminated to show the sustainability and reduction in the losses and increased income (Qu *et al.*, 2021). Reducing food losses in developing countries is more urgent. Therefore, against this background, the study assesses the level of adoption of IPHTRP among the women in Niger State, Nigeria. The specific objectives of the study are to:

- (i) describe the socio-economic characteristics of the women rice processors in the study area;
- (ii) ascertain the institutional and technological factors that affect the level of adoption of IPHTRP;
- (iii) evaluate the level of adoption of the IPHTRP by the women; and
- (iv) constraints faced by the women rice processors in the use of IPHTRP.

METHODOLOGY

Study Area

This study was conducted in the Niger State of Nigeria, which lies appropriately on longitudes 5.5° 98' and 3° E and latitudes 9.9° 30' and 9° N in the North central geopolitical zone of Nigeria. Niger State occupies about 76,363 square kilometres (29,484 sq mi) of land mass, with a population of 6,783,300, as documented (National Bureau of Statistics (NBS), 2024).

Sampling of Data Collection

The population of the study included women rice processors across the three agroecological zones (1, 2, and 3) in Niger State. A multistage random sampling procedure was used in collecting primary data from 424 women rice processors from rice processing cooperative societies.

Method of Data Collection

The survey instrument used for data collection was a structured questionnaire administered as an interview schedule to elicit information from the women. It was augmented using key informant interviews scheduled for some NCRI staff to elicit more detailed information and views of the experts.

Method of Data Analysis

The data for the study were analysed using descriptive statistics and inferential statistics, such as frequency, table, chart, percentage, mean score, graphical illustration, multiple regression and thematic analysis to achieve specific objectives. The perception analysis on the level of adoption of IPHT4RP was used to draw inferences of the women rice processors' view and were then categorized as follows: 1.00-1.49 = Non-adopters; 1.50-2.49 = Least adopters; 2.50-3.49 = Moderate adopters;



3.50-4.49 = High adopters and 4.50-5.00 = Very High adopters. And, were measured through a 5-point Likert-type scale as applicable to this study and the mean was tabulated and presented.

RESULTS AND DISCUSSION

Socio-economic Profile of the Women (Adopters and Non-adopters)

The results presented in Table 1 showed that more than half (52.07%) and about a quarter (33%) of the adopters and non-adopters were within the ages of 30–39 years. The mean ages for adopters and non-adopters of IPHTRP were 36 and 41 years, respectively. This indicated that the women rice processors were generally in their active prime years in the study areas. When women rice processors are young, they are more likely to be efficient in labour-tasking jobs such as rice processing, packaging, storage, and marketing. This finding is in agreement with Tsado *et al.* (2014), who reported that women involved in rice farming had received training on improved rice processing technologies.

The results revealed that about 34% and 20% of adopters and non-adopters had a primary school, while 18% and only 4% of adopters and non-adopters attained secondary education, respectively. Only 1% of the non-adopters had tertiary education, while 5% of the adopters had tertiary education. This finding indicated that adopters and non-adopters were literate and had different levels of education. This suggests younger women with formal education are more likely to adopt new technologies due to their openness to innovation and improved access to information, indicating that adopters have received some level of formal education (secondary or higher) than non-adopters, which means they are more likely to access information about new technologies and understand their benefits. This finding is in line with a study by Tsado *et al.* (2014), and Halliru *et al.* (2021), which reported that the majority of women had received some form of education.

Table 1: Socio-economic Characteristics of Adopters and Non-adopters of IPHT4RP

| Variable | Adopters | | Non-adopters | |
|----------------------------|--------------|------------|--------------|------------|
| | Freq. | Per cent | Freq. | Per cent |
| Age category | | | | |
| 20-29yrs | 34 | 16 | 12 | 6 |
| 30-39yrs | 110 | 52 | 71 | 33 |
| 40-49yrs | 60 | 28 | 97 | 46 |
| 50-59yrs | 4 | 2 | 25 | 12 |
| 60≥ | 3 | 1 | 7 | 3 |
| Total | 212 | 100 | 212 | 100 |
| Mean | 36 | | 41 | |
| Std. dev | 6.400 | | 8.344 | |
| Educational status | | | | |
| Adult education | 34 | 16 | 98 | 46 |
| Primary school | 42 | 20 | 72 | 34 |
| Qur'anic | 86 | 41 | 31 | 15 |
| Secondary | 38 | 18 | 9 | 4 |
| Tertiary | 11 | 5 | 2 | 1 |
| Total | 212 | 100 | 212 | 100 |
| Years of experience | | | | |
| 1-5yrs | 56 | 27 | 85 | 40 |
| 6-10yrs | 96 | 45 | 109 | 51 |
| 11-15yrs | 37 | 18 | 11 | 5 |
| 16≥ yrs | 23 | 11 | 7 | 3 |
| Total | 212 | 100 | 212 | 100 |
| Mean | 9 | | 6 | |
| Std. dev | 5.950 | | 2.509 | |



Institutional Influence on the Women Rice Processors (Adopters and Non-adopters)

The results in Table 2, show that the majority (91%) of adopters were members of cooperative societies, while only 9% of non-adopters do not belong to any of these societies. Of the 192 and 10 adopters and non-adopters who were members of cooperative societies, a proportion of 48% and a large portion of 70% of the adopters and non-adopters had 5-8 years and 1-4 years of membership in cooperative societies, respectively, with a mean of 5 and 3 years. This implied that cooperative membership can provide access to pooled resources, bulk discounts on inputs and equipment, collective bargaining power, knowledge sharing, training, and technical assistance for new technologies like rice processing. This finding is in variance with Chukwu *et al.* (2016), who reported that the majority (70.42%) did not belong to any cooperative society, whereas a few (29.58%) were members of a cooperative society.

Furthermore, the results in Table 2, indicated that (81%) and (10%) of adopters and non-adopters of IPHTRP had access to extension agents, respectively. Of the 171 and 21 adopters and non-adopters who had access to extension agents, a large portion (89% and 95%) of the adopters and non-adopters) were visited 1-3 times by extension agents, with a mean of 2 years, respectively. This suggests that regular interaction with extension services can significantly influence adoption decisions, providing crucial information and guidance that non-adopters may miss. This finding is in disagreement with the findings of Chukwu *et al.* (2016), who observed that 49.58 per cent of the respondents could not have frequent access to extension services, whereas a few (10 per cent) had frequent access to extension services.

Table 2: Distribution of Adopters and Non-adopters of IPHTRP based on Institutional Characteristics

| Variable | Adopters | | Non-adopters | |
|----------------------------|--------------|------------|--------------|------------|
| | Freq. | Per cent | Freq. | Per cent |
| Cooperative society | | | | |
| Yes | 192 | 91 | 10 | 5 |
| No | 20 | 9 | 202 | 95 |
| Total | 212 | 100 | 212 | 100 |
| Years of Membership | | | | |
| 1-4 years | 79 | 41 | 7 | 70 |
| 5-8 years | 93 | 48 | 3 | 30 |
| 11 years and above | 20 | 10 | | |
| Total | 192 | 100 | 10 | 100 |
| Mean | 5 | | 3 | |
| Std. dev. | 1.749 | | 1.449 | |
| Extension contacts | | | | |
| Yes | 171 | 81 | 21 | 10 |
| No | 41 | 19 | 191 | 90 |
| Total | 212 | 100 | 212 | 100 |
| Number of contacts | | | | |
| 1-3 times | 152 | 89 | 20 | 95 |
| 4-6 times | 19 | 11 | 1 | 5 |
| Total | 171 | 100 | 21 | 100 |
| Mean | 2 | | 2 | |
| Std. dev. | 0.857 | | 0.814 | |

Level of Adoption of the Improved Post-harvest Technologies for Rice Processing

Results on adoption in Table 3, showed there were disparities in the adoption of IPHTRP between the women rice processors within and outside the study communities, based on the perception index range, with an average total mean score ($\bar{x} = 4.9$) found generally for level of



adoption. The mean score ($x=1.1$) was obtained for the destoner, ($x=0.9$) for the concrete dry slab, ($x=0.8$) for the False bottom, ($x=0.5$) for the stitching machine, ($x=0.5$) for weighing scale, ($x=0.4$) for package machine, ($x=0.3$) for tarpaulin, while ($x=0.4$) for rice milling machine were found always used respectively. The reported statement shows that, generally, both women rice processors have experienced some level of adoption of the IPhT4RP as indicated, based on the index score range ($x=4.9$) and were profound high adopters in the study areas. Also, it implied that the level of adoption of the IPhT4RP was based on the relative advantages of technologies introduced to the women rice processors in the study areas. This is contrary to the study of Ojo *et al.* (2018), who reported a relatively low level of adoption of rice processing technologies among rice processors in Ekiti State, Nigeria. The implication is that the adoption of IPhT4RP could translate to an increase in the quantity and purity of locally processed rice, which invariably will bring about more adoption of the technologies respectively; in the study areas.

Table 3: Distribution of Women based on Technology Adoption in Rice Processing (pooled data) =424

| Improve post-harvest technologies for rice | Weighted scores | | | Mean score |
|--|-----------------|-------|-----------|------------|
| | Always | Never | Sometimes | |
| False bottom | 158 | 116 | 64 | 0.8 |
| Destoner | 100 | 69 | 47 | 0.5 |
| Stitching machine | 258 | 185 | 41 | 1.1 |
| Weighing scale | 100 | 88 | 42 | 0.5 |
| Packaging materials | 100 | 56 | 34 | 0.4 |
| Concrete drying slab | 200 | 143 | 27 | 0.9 |
| Tarpaulin | 100 | 18 | 17 | 0.3 |
| Rice milling machine | 100 | 29 | 26 | 0.4 |
| Average total mean score | | | | 4.9 |

Factors Affecting Adoption Level of Improved Post-Harvest Technologies for Rice Processing among Women Rice Processors

The results of the Multiple regression presented in Table 4, showed that household size, experience in rice processing, extension contacts, access to markets, and technology accessibility are statistically significant ($P<0.01$) and ($P<0.05$), respectively. The result showed that the years of experience in rice processing were directly related to the level of adoption and was significant ($P<0.05$). The implication is that an experienced woman rice processor is more likely to be interested in the adoption of IPhTRP than someone with fewer years of experience. The results also revealed that household size was positive and significant ($P<0.01$) on the adoption of IPhTRP. This implied that effective household sizes could serve as a substitute for hiring labour to utilise the IPhTRP. The findings agree with the study by Sodjinou *et al.* (2015), who reported positive and significant effects of household size on the adoption of improved technology. This also corroborates the results of Awoyemi and Aderinoye-Abdulwahab (2019), who found that large family sizes are a feature of most rural settings in developing countries and signify the possibility of family labour use. The result also showed that extension contact was positive and significant ($P<0.05$) in influencing the level of adoption of the IPhTRP. This implied that extension contact is a crucial factor that promotes adoption. A similar outcome was also found by Adeogun *et al.* (2008), and Adeniji (2002), which enhanced the level of adoption among women in the study area. Results show the coefficient of access to markets (-2.643) was negatively related to the adoption of improved postharvest technologies for rice processing and was significant at ($P<0.05$). This implies that access to markets has a direct effect to influence the adoption of IPhT4RP.



Table 4: Factors Influencing the level of Adoption of Improved Post-harvest Rice Processing Technologies

| Variables | Coefficient | Std. Err | T-value | P> t |
|-------------------------------|-------------|----------|---------|-------|
| Age | 0.28579 | 0.76187 | 0.38 | 0.708 |
| Educational level | 0.11011 | 0.87732 | 0.13 | 0.900 |
| Marital status | -0.92997 | 0.78761 | -1.18 | 0.239 |
| Experience in rice processing | -2.06837** | 0.85695 | -2.41 | 0.016 |
| Household size | 2.58474*** | 0.86990 | 2.97 | 0.003 |
| Extension contacts | 1.98739** | 0.96987 | 2.05 | 0.041 |
| Access to credit | 0.07774 | 0.84154 | 0.09 | 0.926 |
| Membership of association | 0.42833 | 1.14741 | 0.37 | 0.709 |
| Access to markets | -2.64370** | 1.32231 | -2.00 | 0.047 |
| Technology affordability | 0.23789 | 1.37837 | 0.17 | 0.063 |
| Technology accessibility | 2.65839 | 1.34125 | 1.98 | 0.048 |
| Technology durability | -0.45040 | 1.37155 | -0.33 | 0.743 |
| Technology usability | 0.19324 | 1.01064 | 0.19 | 0.849 |
| _cons | 13.65433 | 0.80007 | 17.07 | 0.000 |
| Prob > F | 0.0005 | | | |
| R-squared | 0.7190 | | | |
| Adj R-squared | 0.6911 | | | |

Note: *, **, *** represent significant at 10%, 5% and 1% levels of significance

Constraints to IPhT4RP Adoption Faced by the Women in the Study Area

In conclusion, the barriers identified in this study underscore significant impediments to the successful adoption of Improved Post-Harvest Technology for Rice Processing (IPhTRP) by women rice processors. The overwhelming accord among the women emphasized issues such as inadequate funding, perceived ineffectiveness of the technology, and low demand for processed rice, which collectively contribute to a challenging scenario for adoption. Additionally, inadequate training and technical support further exacerbates these difficulties, leaving many of the studied women unprepared to implement and benefit from the advancements offered by the IPhTRP. The findings further clarify a critical need for targeted interventions that address not only financial support but also the improvement of the technology itself to enhance its applicability and effectiveness. Moreover, increasing the demand for processed rice through strategic market initiatives could create more favourable conditions for adoption. It implies that the acknowledgement of poorer quality paddy in remote areas as a significant barrier also calls for initiatives that ensure better access to quality inputs. In due course, addressing these multifaceted challenges is vital in empowering women rice processors, thereby enhancing their economic independence and improving their overall quality of life. The implication is that, sustainable solutions that integrate training, financial support, and market access to unlock the potential of women in this sector will foster a more equitable agricultural system.

Table 5: Constraints to the Adoption of IPTRP

| Perceived constraints | Percentage | Rank |
|---|------------|------------------|
| Insufficient funds for business | 97.14 | 1 st |
| Inadequacy of the IPhTRP | 81.43 | 2 nd |
| Low demand for rice-processed | 62.86 | 3 rd |
| Inadequate training/ technical support | 57.14 | 4 th |
| Inadequate subsidies on the IPhT4RP in remote areas | 54.29 | 5 th |
| Inadequate and low-quality of paddy | 54.29 | 5 th |
| Low level of education | 52.86 | 7 th |
| High cost of rice processing machines | 34.29 | 8 th |
| Inadequate extension contacts and advisory services | 31.43 | 9 th |
| Cultural/ norms barriers | 0.00 | 10 th |



CONCLUSION AND RECOMMENDATIONS

The study concluded experience in rice processing, household size, extension contact and access to market were the significant factors influencing the adoption of improved post-harvest technologies for rice processing among female rice processors in the study area. Also, the skills of the women rice processors were enhanced, rice processing quality improve, and workload reduce using the IPhTRP. However, some challenges persist including inadequate funding, ineffective implementation of the IPhT4RP, and low demand for processed rice.

Strategically, to overcome these impediments recommendations were made.

- i. Both non-government and government organizations prioritize training and capacity building for women rice processors.
- ii. Non-government and government organizations should facilitate access to fair prices for paddy and create a stable market for processed rice.
- iii. Extension agents should also provide regular follow-ups and technical support to address any challenges that may arise after adoption of technologies.

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