ADOPTION OF FALSE BOTTOM TECHNOLOGY AMONG TRAINED RICE PROCESSORS IN NORTH CENTRAL, NIGERIA

[*]Salami, O.S. and [**]Adisa, R.S

[*]Rural Infrastructure and Institution Development, Department of Rural Development and Gender Issues, Agricultural and Rural Management Training Institute (ARMTI), Ilorin, Nigeria.

[**]Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, Nigeria.

ABSTRACT

Rice processing enterprise has a lot of potentials for generating income and improving the welfare of households in Nigeria. Despite the attempt to improve the capacity of processors for improved rice quality in Nigeria by Japan International Cooperation Agencies (JICA), the quality of local rice grains remain poor and characterised by black colour, brokenness and presence of stones. This study therefore examined the adoption of false bottom parboiling technology (FBT) among rice processors in North Central Nigeria. Three-stage sampling technique was employed to select 385 rice processors. Data collected were analysed using descriptive and inferential statistics including mean, percentages and regression analysis. The study found that majority (60.5%) of the rice processors highly adopted the FBT. The coefficient of membership of group (0.177, $p<0.05$) of the rice processors were positive and significant to adoption of false bottom technology. This study concludes that false bottom technology practices are highly adopted by rice processors in North-central Nigeria. Thus, this study suggests that processors who are non-members should join agro-processing group or form one where none is existing. Extension agents should further mobilize to encourage processors to participate in membership association so that information on improved processing technology can be easily sourced through farmers' group/cooperative.

Keywords: False bottom technology, rice processors, membership of group, family headship

INTRODUCTION

Rice is one of the major staple foods in Nigeria (Oladimeji, Hussain, Sanni, & Abdulrahman, 2020). Producers (farmers) and processors are the main actors in rice value chain in Nigeria (Okonkwo, Ukaogo, Kenechukwu, Nwanshindu, & Okeagu, 2021). Rice processing entails methods used to prepare rice for use or preservation by removing the husks and sometimes polishing the grains to get it white (Adejoh, Madugu & Shaibu, 2017). Operations during processing are aimed to change its form while maintaining the quality (Zohoun *et al.* 2018). Other purpose of rice processing is mainly to reduce food losses, enhance food security, generate income especially for households and stimulate local production (Kwofie and Ngadi, 2017).

Rice parboiling is a significant step in rice processing. Rice parboiling is a hydrothermal process which entails heat treatment to gelatinize the starch in rice kernel resulting in irreversible swelling and fusion of starch granules (Danbaba, Idakwo, Kassum, 2019). Parboiling of paddy requires three steps: soaking, steaming and drying. The parboiling help to reduce rice breakage on milling as well as change the cooking characteristics and achieve desirable flavour, impact different heating characteristics, reduces losses of nutrient during milling (Rahimi-Ajdadi, Asli-Ardeh, and Ahmadi-Ara, 2018).

The False Bottom technology (use of lid and false bottom) is an improved method of parboiling paddy rice introduce by the Japan International Cooperation Agency (JICA) in Nigeria. JICA is a governmental agency that delivers the bulk of Official Development Assistance (ODA) for the government of Japan (Takahashi et al., 2019) having office in Nigeria. The Federal Ministry of Agriculture and Rural Development (FMARD) and JICA partnered to develop False Bottom Technology for efficient rice parboiling process (JICA, 2016). A pilot project called Rice Post Harvest Processing and Marketing Pilot Project (RIPMAPP) was conducted in North-central States (FCT, Niger and Nasarawa States) from the year 2011 to 2016 with the purpose of improving the capacity of rice processors in Nigeria through the use of False Bottom Technology (RIPMAPP, 2016). Because of the technology adaptability and implication on market price, other rice parboilers in North-central states have adopted this technology through extension agents of state ADPs and some by spillover effect. As of January 2018, 14,216 parboilers in 21 states (Including states in other geopolical zones) have started using the technology in Nigeria (JICA, 2019). The false bottom can be made/developed using sand-casting aluminum for a rice cooking pot through local fabricators. The recommended specifications for making sand-casting aluminum for false bottom are: 560 mm diameter, 10mm thickness, 3mm diameter of a hole for steam, and the number of holes should be 70 (Bolarin *et al*., 2022).

JICA recommends utilising a lid and a false bottom regardless of the shape of containers and volume of paddy for steaming. Using a false bottom solves problem of over-cooking. A lid ensures equal heat treatment by steam within a steaming container. Thus, by using a lid and a false bottom, the quality of parboiled rice, especially pertaining to discolouration and unevenness of colour improves. A false bottom separates the water and the wet paddy in the container. The water under the false bottom is boiled and is changed into steam by heating the container. The steam passes through the holes of the false bottom and through the mass of paddy above the false bottom. The boiling water is not in direct contact with the paddy and therefore does not deform the grains at the lower portion of the container (Adeola *et al*., 2019).

Though, several studies have investigated the adoption of technologies for improve livelihood of users among rice processors in North central Nigeria (Salami, Babatunde, Ayinde, and Adeoti, 2017; Saliu et al. 2016; Ajibola, 2017) but the level of adoption and adoption accuracy of false bottom technologies among rice processors in North-Central Nigeria are yet to be determined. Hence, there is paucity of literature on the level of adoption and accuracy of adoption of false bottom technologies among rice processors in North-Central Nigeria. The need to bridge this research gap lies in its importance for extension policy process that can further better extension delivery of the technology to be adopted by rice processors in North-central States. It is against this background that this study was set out to study adoption level and adoption accuracy of false bottom technology among rice processor in North-central Nigeria.

The broad objective of this study is to examine the adoption of false bottom parboiling technology among rice processors in North-central, Nigeria. The study specifically describes the socioeconomic characteristics of respondents, and assesses the influence of socioeconomic characteristics on the adoption level of false bottom parboiling technology among the respondents.

METHODOLOGY

The research was carried out in North-central States of Nigeria. The region is made up of six states namely Benue, Kwara, Niger, Plateau, Nassarawa, Kogi and the Federal Capital Territory (FCT). North-central is located in the southern Guinea savannah agro-ecological zone (National Bureau of Statistics 2019) and lies approximately between 3˚ and 14˚E and latitude 7˚ and 10˚N. Temperature ranging from 18^oC – 37^oC yearly while rainfall ranging from 1000mm to 1500mm per annum.

The study population comprised of all FBT trained rice processors in North-central States: namely Kwara, Niger and Kogi. Three-stage sampling technique was employed to select rice processors. First stage involved a purposive selection of 3 states where the JICA programme was implemented. The selected states were Niger, Kwara, and Kogi states. The Second stage involved a purposive selection of rice producing communities where JICA programmes were implemented. The selected communities were Niger State - Lavun, Wushishi, Bida and Paikoro; Kwara State - Edu and Pategi; Kogi State – Lokoja, Kogi, Idah and Ibaji. The third stage involved a proportionate sampling of 3.8% of 10,125 population of processors that benefited from JICA programme in the 3 selected states to arrive at 385 processors used as respondents for this study.

Determination of sample size was done with the use of Yamane Formula expressed mathematically as:

$$n = \frac{N}{1+N(e)^2} n = \frac{N}{1+N(e)^2}$$ …………………equation 1

Where; n= sample size; N= finite population (10,125); e= limit of tolerable error (0.05)
1= unity; n = 384.8 = **385** respondents

Table 3: Summary of sampling procedure and sample size

Stage 1 Purposive selection of pilot states in North-central and Rice producing LGAs	Stage 2 Purposive selection of rice producing LGAs	Population of trained rice processors by JICA (JICA, 2018)	Stage 3 3.8% of the population
Kwara State	Edu	1,100	42
	Patigi	1,310	50
	Sub-total	2,410	92
Niger State	Lavun	711	27
``	Wushishi	1005	38
	Bida	842	32
	Paikoro	1158	44
	Sub-total	3,716	141
Kogi State	Lokoja	1000	38
	Kogi	974	37
	Idah	842	32
	Ibaji	1183	45
	Sub-total	3,999	152
Total		10,125	385

Source: Authors' Computation

The study drew its information from primary data sources. Data for the study was collected with the use of an interview schedule through survey. Descriptive statistics involving the use of frequency counts, percentages, mean scores and standard deviations and regression (OLS) were employed in analyzing primary data collected. Respondents were asked to indicate their present stage of adoption **of** False Bottom Technology on the following scale: Awareness=1, interest=2, evaluation=3, trial=4 and use=5.

Adoption Index: Adoption index of individual processors was calculated using the formula adapted from Abubakar *et al.* (2016). Simple descriptive statistics (frequency count and percentage) was used to determine the rice processors' distribution across adoption categories.

To classify the adoption in different categories, the adoption index of each respondent was computed using this formula:

$$Adoption\ index = \frac{Respondents\ total\ score\ (?)}{Total\ possible\ score\ (5 \times 17\ = 85)} \times 100 \ldots\ldots\ldots.equation\ 3$$

Minimum possible score = 17 with 20% as minimum adoption index

Maximum possible score = 85 with 100% as maximum adoption index

Based on the adoption index scores of the processors ranging from 20% to 100%, the rice processors were grouped into three adoption level as follows:

20% - 46% = Low adopters

47% – 73% = Average adopters

74% – 100% = High adopters

Ordinary Least Square regression

Ordinary least square regression is a method for estimating the unknown parameters in a linear regression model. The model was specified implicitly thus:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 + \ldots . + e_i$ ... ... (Equation 1)

Where,

Y (Dependent variable) = Adoption of False Bottom Technology (individual adoption score)

(X) = Independent variables

X_1 = Sex (female=1, male=0)

X_2 = Age (in years)

X_3 = Education (in years of schooling)

X_4 = Experience in rice processing (in years)

X_5 = Membership of group (yes=1, no=0)

U= Error term

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Information on socioeconomic characteristics of respondents was gathered. Details of the results were presented in Table 1.

Table 1: Socioeconomic characteristics of respondents

Variables	Freq.	Percentage	Mean	Std Dev.	Range
Sex					
Male	30	7.8			
Female	355	92.2			
Age (years)			45.1	0.268	26.0 – 78.0
26 – 38	73	19.0			
39 – 51	233	60.5			
52 – 64	72	18.7			
Above 64	7	1.8			
Years spent in school					
0 (No formal education)	82	21.3			
1 – 6 (Primary education)	54	14.0			
7 – 12 (Secondary education)	138	35.8			
Above 12 (Tertiary education)	111	28.8			
Years of experience			16.2	10.09	3.0 – 40.0
≤ 10	171	44.4			
11 – 20	96	24.9			
21 – 30	85	22.1			
31 – 40	33	8.6			
Mem. of agro-processing group					
Yes	280	72.7			
No	105	27.3			

Source: Field survey, 2023

Result on sex in Table 1 indicated that 92.2% of the respondents were females while 7.8% were male. This indicated that rice processing activities in the study area were female dominated. This finding conforms with that of Salami *et al.* (2017) who reported that majority of rice processors in North-central state of Nigeria were females. Again, it is a popular saying that women are more involved in agricultural processing. Results presented in Table 1 shows the average age of all respondents was 45.1 years. This implies that rice processors in North-central Nigeria are in their active and productive age (less than 50 years) and are expected to have the ability to carry-out rice processing activities as well as use processing technology that require physical strength effectively, and if adequate supplied to them, their processing activity can improve. Further results in Table 1 show that 21.3% of the respondents had no formal education, 14.0% had primary education, 35.8% had secondary education while 28.8% had tertiary education. This implies that majority of the rice processors in the study area had one form of education or the other and able to read and understand instructions to use false bottom technology practices. Also the respondents should be able to write extension organizations requesting for specific assistance on the use of false bottom technology.

The average year of experience for all respondents was 10.4 years ranging from 3 to 40 years. This shows that rice processors in the study area had accumulated appreciable years of experience and long enough to understand some profitable practices (modern-false bottom technology or indigenous) for rice processing business which will in no doubt lead to increase in specialization of skills and knowledge required in facilitating their processing ability. More experienced processors are expected to be more knowledgeable and they should have mastered the best processing techniques to utilize in order to reduce the time and cost of processing. This finding is in line with that of Chikaire *et al.* (2017) who posited that the longer time a person spends in a particular business, the more skillful and experienced they become in its management. The result in Table 5 showed that 72.7% were members of agro-processing group while 27.3% were non-members. The average year of membership of the respondent in agro-processing group was 6.5 years. This finding indicates that majority of rice processors in the study area were members of agro-processing group.

Adoption of False Bottom Technology (FBT) among Rice Processors

The results of analysis of the adoption of false bottom technology practices among processors were presented in two sections (Table 2), namely adoption practices and adoption level or categories of adoption of false bottom technology (Table 3).

Table 2: Adoption of false bottom technology among respondents

FBT specifications	WMS	SD	Decision
Clean paddy, free of impurities and dry well (moisture rate 12- 14%).	3.48	1.58	High
Determine if the paddy is dry: uses the salt method: – Mix in a bottle (e.g. bottled mayonnaise) two volumes of paddy with one salt volume, then close and stir thoroughly; – If the paddy glue on the cover, this indicates that it is not dry enough.	3.87	1.30	High
Day 1: Washing and soaking			
Washing			
Thorough washing in clean water to remove chaff, empty grains, stones, debris and sand	3.44	1.56	High
Soaking			
Prepare water for soaking paddy of temperature at 65 – 70 Degree Celsius.	3.66	1.44	High
Soak paddy for 8 to 10 hours to ensure the moisture content of paddy be at 30% to 35%.	3.53	1.52	High
Day two: Steaming and drying			
Steaming			
Drain water properly from soaked paddy	3.76	1.39	High
Add small quantity of water into the steaming pot.	3.86	1.33	High
Place a false bottom in the pot with the following specification: Diameter: 560mm, Thickness: 10mm, Diameter of a hole for steam: 3mm and Number of the holes: 700. The false bottom should be placed above the water in the pot. Then, pour soaked paddy into the pot	3.93	1.23	High
Place a lid to cover the pot properly.	4.11	1.12	High
Allow it to steam for some time, monitor the paddy until the paddy at the top get cracked open, then stop steaming.	3.97	1.23	High
The surface of the top portion has to be checked when steaming time reaches 5 to 6 minutes.	3.91	1.30	High
Stop steaming 7 to 9 minutes after observing the very first steam coming from the top portion of the paddy layer and the paddy at the top get cracked open, then stop steaming.	3.84	1.31	High
Drying			
Spread steamed paddy, accumulated not more than 2cm, on clean concrete.	3.77	1.34	High
Turn over steamed paddy sometime during sun drying.	3.50	1.54	High
Stop drying at moisture contents of 12.5 – 13.0%.	3.80	1.35	High
Allow dried paddy to cool down over night.	3.62	1.52	High
Day 3: Milling			
Put dried paddy in bags and proceed to milling station.	3.51	1.67	High

WMS=Weighted Mean Score; SD=Standard Deviation; Mean ≥ 3.0 = high adoption

Result displayed in Table 2 indicates the adoption process of FBT among respondents. The table showed that all specified task to perform FBT were highly adopted by the respondents. It could be deduced from the result that false bottom procedure of steaming was most adopted as highest weighted mean score of the respondents adopted the practice of placing a lid to cover the pot properly (wms=4.11), allowed it to steam for some time, monitor the paddy until the paddy at the top get cracked open, then stop steaming (wms=3.97), placing a false bottom in the pot with the following specification (wms=3.93), the surface of the top portion has to be checked when steaming time reaches 5 to 6 minutes (wms=3.91), and stop steaming 7 to 9 minutes after observing the very first steam coming from the top portion of the paddy layer and the paddy at the top get cracked open, then stop steaming (wms=3.84).

Table 3: Individual processors score on adoption of false bottom technology

Obtained score	Percentage score	Level of adoption	Frequency	Percentage	Mean obtained score on adoption of all processors
17 – 39	(20% – 46%)	Low	32	8.3	
40 – 62	(47% – 73%)	Average	120	31.2	
63 – 85	(74% – 100%)	High	233	60.5	63.6 (74.9%)
Total			385	100.0	

Minimum – Maximum possible scores = 17 – 85

According to the result presented in Table 3, the minimum score an individual can obtain on usage is 17 while the maximum is 85, therefore the result shows that 8.3 per cent of the respondents fall on the score category between 17–39 (20% – 46%), 31.2 percent of the respondents on the score category between 40–62 (47% – 73%) and 60.5 percent on the category between 63–85 (74% – 100%). However, the overall processors' obtained score (average score) and percentage usage of the false bottom technology was 63.6 (74.9%). This shows that false bottom technology practices are highly adopted by rice processors in the study area.

High level of adoption rate of the FBT is a reflection the persuasion process of the processors about their knowledge of FBT. That is, mental evaluation of the available information on the FBT technology. This shows that the analysis is positive, a situation where the farmer/processors will first use it on a small scale, and then expand its application (Rogers, 2003). This implies that high knowledge of FBT previous reported is what translated to high level of use or adoption of the technology. In similar, several studies have posited that knowledge and information about agricultural technology increases the tendencies for adoption rate (Liu, Shi, Peng, Wang & Fu, 2022).

Regardless of the adoption level of the processors about FBT, adoption and use of FBT does not translated to usage according to specification by JICA. It is possible for an adopter to partly comply with some specifications and neglect other based on the judgement of importance or proficiency of usage. Studies have indicated that the level of technical efficiency/proficiency to perform the task according to specification played major role for accurate adoption as it could be applicable to FBT that each steps require specifications (DeLay, Thompson, & Mintert, 2021).

Determinants of processors' adoption level of false bottom technology

Factors determining the adoption of false bottom technology were assessed with multiple regression (OLS). Results were presented in Table 4.

Table 4: Result of Ordinary Least Square Regression showing the determinants of adoption of false bottom technology

Adoption of FBT	Coefficients (β)	Std. Error	Sig.
(Constant)	3.406	0.452	0.000
Sex	-0.104	0.145	0.476
Age	-0.009*	0.005	0.035
Years of schooling	0.003	0.007	0.677
Years of experience	0.008	0.005	0.106
Membership of group	0.303**	0.139	0.030

a. Dependent Variable: Adoption of false bottom technology
R = 857
R square = 0.734 = **73.3%**
Adjusted R square = 0.733
Std Error of the Estimate = 5.9717
F-statistics = 527.644
Sum of square residual = 13622.554
*,** Significant at 5% and 1% level respectively

The result from regression analysis in Table 4 shows that some socio-economic factors significantly influenced the adoption of false bottom technology (R^2 = 0.734, F = 527.644, $p < 0.01$). On the whole, the socio-economic factors predicted only 73.3% of rice processors influence to adopt false bottom technology. The coefficient of membership of group (0.177, $p<0.05$) of the rice processors were positive and significant to adoption of false bottom technology. This indicated that there were direct relationship between rice processors' membership of group and their adoption level of false bottom technology. This indicates that joining a processing group will lead to a marginal increase in their adoption level by 0.177 units. Furthermore, years of age (-0.097, $p <0.05$) of the rice processors showed negative significant relationship with the adoption of false bottom technology. This indicated that there were inverse relationship between the age of processors and their adoption level of false bottom technology.

CONCLUSION AND RECOMMENDATIONS

Based on the major findings of this study, this study concludes that False bottom technology practices are highly adopted by rice processors in North-central Nigeria. Factors supporting high adoption were membership of group and family headship of the rice processors. Thus, this study suggests that processors who are non-members should join agro-processing group or form one where none is existing. Processors who are members are encouraged to fully participate in group activities. Existing groups should ensure strong cohesion and strive to focus objectives of the group on members' needs related to the usage of improved processing technology. Extension agents should further mobilize to encourage processors to participate in membership association so that information on improved processing technology can be easily sourced through farmers' group/cooperative.

REFERENCES

Abubakar H.N., Garba, Y., Gana, A.K., & Jocob, I.A. (2019). Factors influencing adoption of rice improved production practices by farmers in adopted villages, Niger state, Nigeria. *Advances in Plants & Agriculture Research, 9*(1), 183–189.

Adejoh, S.O., Madugu, N. & Shaibu, U.M. (2017). An Assessment of the Adoption of Improved Rice Processing Technologies: A Case of Rice Farmers in the Federal Capital Territory, Abuja, Nigeria. *Asian Research Journal of Agriculture, 5*(4), 1-9.

Adeola, R.G., Ogunleye, K.Y., & Adewole, W.A. (2019). Adoption intensity determinants for improved sweet potato varieties among farmers in Nigeria. *International Journal of Agricultural Management and Development, 9*(3), 203-211.

Ajibola, B.O. (2017). Factors affecting adoption of urea deep placement technology by rice farmers in Kwara State, Nigeria. *Journal of Agricultural Research and Development,* 16:1

Bolarin, O., Adebayo, S.A., Akubo, R.A. & Komolafe, S.E. (2022). Perceived effectiveness of Japan international cooperation agency–rice processing technologies utilization among rice processors in Kogi State, Nigeria. *SVU-International Journal of Agricultural Sciences, 4* (3), 58-67. http://doi.org/10.21608/svuijas.2022.127018.1196

Chikaire, J.U., J.O. Orusha, A. Tim-Ashama, F.E. Nwarieji, and P.C. Amanze. (2016). Perceived Effects of Insecure Land Rights on RuralWomen's Roles in Household Food Security in Okigwe Agricultural Zone of Imo State, Nigeria. *Basic Research Journal of Soil and Environmental Science 4*(1): 06–14.

Danbaba, N., Idakwo, P.Y., Kassum, A.L., Bristone, C., Bakare, S.O., Aliyu, U., Kolo, I.N., Abo, M.E., Mohammed, A., Abdulkadir, A.N., Nkama, I., Badau, M.H., Kabaraini, M.A., Shehu, H., Abosede, A.O. & Danbaba, M.K. (2019). Rice Postharvest Technology in Nigeria: An Overview of Current Status, Constraints and Potentials for Sustainable Development. *Open Access Library Journal*, 6: e5509.

Kwofie, E. M. & Ngadi, M. (2017). A review of rice parboiling systems, energy supply, and consumption. *In Renewable Sustainable Energy Reviews*, 72: 465–472.

Liu, C., Liu, Y., Li, Z., Zhang, G. & Chen, F.A. (2017). Novel Way to Establish Fertilization Recommendations Based on Agronomic Efficiency and a Sustainable Yield Index for Rice Crops. Sci. Rep. 24:1001.

Oladimeji, Y.U., Hussain, A.S., Sanni, S.A., & Abdulrahman, S. (2020). Determinant and profitability of rice farmers' investment in value addition activities in kebbi state, Nigeria, *Dutse int. J. Soc. Econ. Res. 3* (2), 101-109.

Okonkwo, U.U., Ukaogo, U., Kenechukwu, D., Nwanshindu, V. & Okeagu, G. (2021). The politics of rice production in Nigeria: The Abakaliki example, 1942-2020. *Cogent Arts & Humanities, 8*:1, 1880680.

Rahimi-Ajdadi F., Asli-Ardeh, E.S, Ahmadi-Ara, A. (2018). Effect of Varying Parboiling Conditions on Head Rice Yield for Common Paddy Varieties in Iran. *Acta Technologica Agriculturae* 1 : 1–7.

Rice Post Harvest Processing and Marketing Pilot Project (RIPMAPP, 2016): A Guideline for RIPMAPP Technology Dissemination, For High-quality Parboiled Milled Rice by Small-scale Processors. Prepared by The Agribusiness and Marketing Department (ABM), Federal Ministry of Agriculture and Rural Development and Japan International Cooperation Agency (JICA). Avalilable online at http//www.160324.pdf. retrieved on 28/12/2022

Salami, M., Babatunde, R. O., Ayinde, O., & Adeoti, E. O. (2017). Determinants of poverty among local rice processors in Kwara State, Nigeria. *Trakia Journal of Sciences*, *15*(4), 386–391. https://doi.org/10.15547/tjs.2017.04.022

Zohoun, E.V., Tang, E.N., Soumanou, M.M., Manful, J., Akissoe, N.H., Bigoga, J., Futakuchi, K., & Ndindeng, S.A. (2018). Physicochemical and nutritional properties of rice as affected by parboiling steaming time at atmospheric pressure and variety. Food Science and Nutrition. *Food Sci Nutr.* 6:638–652.