RESEARCH ARTICLE

Perceived effectiveness of Japan international cooperation agency– rice processing technologies utilization among rice processors in Kogi State, Nigeria

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Abstract

In recent years, global rice consumption has seen a substantial increase and consumption is expected to continue to rise given its significance in household diets worldwide. The processing, however, requires specific operations to be successful. This study, therefore, investigated the effectiveness of technologies by Japan International Cooperation Agency (JICA) technologies utilized by rice processors in Kogi State, Nigeria. The study recruited 180 processors following three (3) stage sampling procedure. Primary data was collected with a validated and reliable interview schedule. Descriptive and t-test statistics were employed to analyze data. Results revealed that 91.1% of the processors were females with average age of 47.6 years while 56.7% had primary education. It was also found that 72.2% of the processors sourced for information about JICA technologies through agricultural extension agents. Study also found that all JICA technologies were effective. However, quality parboiling of paddy rice with the false bottom ($\overline{X}$ = 3.99) and soaking method ($\overline{X}$=3.98) and whole grains realized when milled by Ajifa ($\overline{X}$ = 3.98) were the leading JICA technologies considered effective by the respondents. The study therefore suggests the implementation of educational programme suitable for adults in order to improve processors' literacy level and knowledge of rice processing business.

Keywords: De-stoning; False bottom; JICA- Rice technologies; milling; parboiling.

1. Introduction

Rice (*Oryza sativa*) is an important nutrition to mankind (Cardoni and Angelucci, 2013). Almost half of the people globally rely on rice as essential food (Oguntade, 2011). Rice is massively cultivated in countries such as Bangladesh, China, Japan, India, Philippines, among others. In Nigeria, rice is one of the country's main staple crops. Majority of Nigerians irrespective of their ethnic group depend on rice as their daily food (Raheem *et al.,* 2021). Rice is gradually becoming the most crucial staple food in Nigeria because it is

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relatively affordable source of carbohydrate as human food and animal feed (Nwozor and Olanrewaju, 2020). Involvement in rice entrepreneurial activities (production and processing) is capable to alleviate poverty and contribute to sustainable livelihood of small scale farmers (Nwahia *et al.,* 2021; Adesiji *et al.,* 2022).

Rice paddy contains the husks, cortex, embryo and endosperm. Processing of the paddy is required through some operations to separate the endosperm from other parts with the least of fragmentation and dirt while preserving the nutritional value (Cardoni and Angelucci, 2013). These operations help to improve rice quality for consumption (Nwozor and Olanrewaju, 2020).

In Nigeria and elsewhere in West Africa, parboiling process are not been performed optimally and the quality of the milled rice varied greatly (Opeyemi *et al.,* 2015). The processors faced several challenges to produce quality rice because the processors still use primitive methods (Nwachukwu *et al.,* 2020). This has resulted in poor quality of local rice characterized with stones, breakages and dark rice while the demand for better quality imported rice had been increasing steadily over the last two decades (Okeke and Oluka, 2017). For these reasons, it is necessary for rice processors to acquire a technique in order to enhance the rice quality capable to contribute immensely to food availability, increase income of farm households and also boost partnership for international trade (Raheem *et al.,* 2021). This is because, improved quality of rice processed will eventually increase demand for local rice and increase income local rice processing. Thus, rice processor would be motivated to expand scale of production.

The effort of Nigeria government to increase rice production, attain self-sufficiency, and revitalization of industrial ability for international quality milled rice, made the Federal Government of Nigeria (FGN) through the Federal Ministry of Agriculture and Rural Development (FMARD) to partners with Japan International Cooperation Agency (JICA) and implementation bodies including the Kogi State Agricultural Development Project (Kogi-ADP) and Ajifa Mill (a modern cottage mill) to introduced the JICA Improved Rice Processing Technologies through the 'Rice Post-harvest Processing and Marketing Pilot Project (RIPMAPP) to small-scale rice processors in Kogi State'. The improved processing practices included: clean drying slab, standard miller and de-stoner while conscious efforts were made to train selected rice processors in the rice producing areas of the state. The training was aimed at improving the capacity of small-scale rice processors and also to make them competent in providing good quality milled rice that is free from stone and other impurities.

The JICA Improved Rice Processing Technologies basically involves the use of a new technology called False Bottom for parboiling of rice paddy, clean drying slab, standard miller and de-stoner in processing rice. The initiative was aimed at encouraging local rice production and processing in commercial quantity so as to bridge the huge gap between domestic demand and supply and also achieve local rice self-sufficiency, attain food security and be nutrition secured in the country. The beneficiaries in 2014-2015, were trained on Good Agricultural Practices (GAP) in rice farming while in 2015-2016, the rice processors were trained on JICA improved rice parboiling technologies by Extension Agents (EAs) from Kogi State Agricultural Development project (Kogi-ADP). The training included methods on Good Family Nutrition.

Ever since the implementation of the programme and utilization of the initiatives in Kogi State, no study has attempted to investigate the effectiveness of utilization of JICA initiatives among the users. Hence, there is dearth of knowledge on the effectiveness of utilization of JICA initiatives in Kogi State. The specific objectives of this study therefore were to: (i) identify the socio-economic characteristics of the rice processors, (ii) investigate their sources of information on JICA rice processing technologies, (iii) assess perceived effectiveness of JICA improved rice processing technologies among rice processors and; (iv) identify the constraints faced by processors in utilizing the JICA processing technologies.

2. Methodology

2.1. Study Area
Kogi State, with its capital in Lokoja, is situated in the North-central (Middle-Belt) of Nigeria, created 27 August, 1991 from parts of Kwara and Benue States. The state is generally known

as confluence state following the meeting of Rivers Niger and Benue. Kogi State is the most centrally located of all the states of the federation and is located between Latitude $7^o30'$N and Longitude $6^o42'$E of the equator (Department of Land Survey Kogi State, 2010). The state has a population of 3,595,789 and occupies a total landmass of about 30, 354.74 sq.km^2 (NPC, 2006). Igala is the largest ethnic group in the state followed by Ebira and Okun. Other minorities include Magongo, Bassa, Oworo, Nupe, Ogori and so on.

The state has two main seasons: the dry and rainy seasons with precipitation occurring between April and October while the weather is usually dry from November and March. The state is blessed with suitable ecological and climatic conditions with an average temperature of 26.8^oC and about 747mm of precipitation/rainfall annually. It is therefore possible to produce various agricultural products like yam, cassava, rice, cowpea, cocoyam, maize, millet, guinea corn, palm produce, melon, groundnuts and others. Indeed, agriculture is the mainstay of the economy and the state's rich agricultural endowment is reflected in its capacity to produce cash crops like cocoa and cashew.

2.2. Sample Procedure and Sample size

A three-stage sampling technique was used for selection of respondents for the study. For the first stage; three (3) Local Government Areas (LGAs) out of the twenty one (21) LGAs of the state were purposively selected and they include, Idah, Ibaji and Igalamela-Odolu LGAs. These areas were selected based on the fact that they are the only areas in Kogi east where JICA training on improved rice processing technologies was conducted. The second stage involved a random selection of three (3) JICA benefitting communities from each of the selected LGAs. The third stage involved a random selection of twenty (20) beneficiaries in each community selected. The total sample size

for the study was one hundred and eighty (180) respondents.

2.3. Data Collection

Primary data were collected using a questionnaire administered through personal interview. Descriptive statistics such as frequency distribution, percentage and mean were used to analyse objectives i, ii and iii. Objective three was measured using four point Likert scale of highly effective=4, effective=3, mildly effective=2, not effective=1. These were summed together (4+3+2+1) and divided by 4 to get a mid-point of 2.5 as benchmark for decision making. That is, mean value $\geq$2.5 were considered effective and mean score <2.5 as not effective.

3. Results and discussion

3.1. Socio-economic characteristics of respondents

Results on Table 1 showed that 60% of the respondents were between 40-49 years. The mean age of the small-scale rice processors in Kogi State was 48 years, showing that they are agile and still within economic active years; hence, they can seamlessly make use of the improved technologies if they choose to. Active age could also translate into increased productivity and engagement in value adding activities such as rice processing. The table further showed that majority (91.1%) of the respondents were female and only 8.9% were male. It can deduced from this result that females are more involved in rice processing in the study area and this finding conforms with that of Salami *et al.* (2017) who reported that majority of rice processors in Kwara State of Nigeria were females. Again, it is a popular saying that women are more involved in agricultural processing.

The results also indicated that majority (86.7%) of the respondents were married. In terms of social obligation, the married processors may have to shoulder lots of responsibilities and also

need to dive into series of production activities with deep commitment for increased income that could support the family's basic needs. Additionally, about 86.7% of the respondents have household size ranging from 4-7, with a mean household size of 6 people. It was previously found that larger percentage of rice processors had moderate household sizes (Adejoh *et al.,* 2017) and it is also noteworthy to mention that rice processing entails various rigorous activities across the rice processing stages and as such, higher household members will help in reducing the cost of processing.

Table 1. Socio-economic characteristics of respondents

Socio-economic Characteristics	Frequency	Percentage	Mean
Age (in years)			
< 30 years	0	0.0	
30 – 39 years	8	4.4	47.6
40 – 49 years	108	60.0	
50 years and above	64	35.6	
Sex			
Male	16	8.9	
Female	164	91.1	
Marital status			
Single	1	.5	
Married	156	86.7	
Divorced	5	2.8	
Widowed	11	6.1	
Separated	7	3.9	
Household size			
< 4 people	2	1.1	
4 – 7 people	156	86.7	5.9
> 7 people	22	12.2	
Level of education			
No formal	66	36.7	
Primary	102	56.7	
Secondary	11	6.1	
Tertiary	1	0.5	
Years of experience in rice processing			
< 5 years	2	1.1	
5 – 9 years	5	2.8	15.8
10 – 14 years	29	16.1	
15years and above	144	80.0	
Purpose for rice processing			
Family consumption only	3	1.7	
Both family consumption and sales	177	98.3	
Rice processing as major occupation			
Yes	165	91.7	
No	15	8.3	

Source: Field Survey, 2021

In terms of level of education, only 56.7% in the study area had primary education while 36.7% had no form of formal education. It is interesting to note that a few (0.5%) had tertiary education. These figures suggest a low level of education among the rice processors; but also imply that they are not totally illiterates. The level of a

processors' education is of paramount importance to their processing skills as it is believed that education makes people more change-oriented. The rice processors in the study have an average of 16 years of experience in rice processing with the majority (80%) having up to 15years of experience. The implication is that the rice processors have been involved in processing activities for a reasonably long period of time. More experienced processors are expected to be more knowledgeable and they should have mastered the best processing techniques to utilize in order to reduce post-harvest loss and the 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 skilful and experienced they become in its management.

3.2. Sources of information on JICA improved rice processing technologies

Table 2 showed that majority (72.2%) of the respondents got information and knowledge about JICA improved rice processing technologies through extension agents, implying that extension agents in the study area were efficient in performing their duty with regards to training on the JICA improved rice processing technologies. This finding is in line with Cordelia and Edwin (2020) who found that

agricultural extension agents contribute positively to rice production in Nigeria. Table 2 further showed that mass media was not in use for dissemination of information about the JICA improved rice processing technologies. However, the speed and widespread coverage of mass media in disseminating agricultural innovation cannot be ignored as information is effectively transferred concurrently; to different persons among various classes of the society at a time. This assertion is in agreement with that of Saleh *et al.* (2018) who reported that mass media are essential in stimulating farmers/processors' interest in new ideas and practices. Mass media help farmers/processors make informed decisions in their farming/processing activities while also reinforcing messages.

Majority (98.3%) of the respondents accepted that the information was of importance to their output level while only 1.7% of the respondents felt otherwise given that their production were strictly for family consumption and that the information was beneficial to the quality of rice they consumed. This is in line with the findings of Adio *et al.* (2016) who posited that, agricultural information services contribute significantly to agricultural production. This is because information is life and a mind that is informed is enriched.

Table 2. Distribution of the respondents based on their sources of information on JICA improved rice processing technologies its importance on processors' output level

Variables	Frequency	Percentage
Sources of information about JICA Improved Rice Processing Technologies		
Family and Friends	50	27.8
Extension Agent	130	72.2
Importance of the information to output level		
Yes	177	98.3
No	3	1.7

Source; Field Survey, 2021

3.3. Difference between the Estimated Quantity of Rice Paddy Parboiled Weekly Before and During the Use of JICA Improved Rice Processing Technologies

Results on Figure 1 showed an improved output level from the use of JICA Technologies. The figure shows that before the use of the JICA technologies, only 2.7% of the respondents

could parboil above 10 bags of 50kg rice paddy weekly, while with the use of JICA Technology, there is greater increase; as 32.2% of the respondents are now capable of parboiling above 10 bags of 50kg rice paddy weekly. According

to Rehman *et al.* (2016) modern/improved agricultural technology helps in obtaining increased farm yield/output and also brings about increased economic profit.
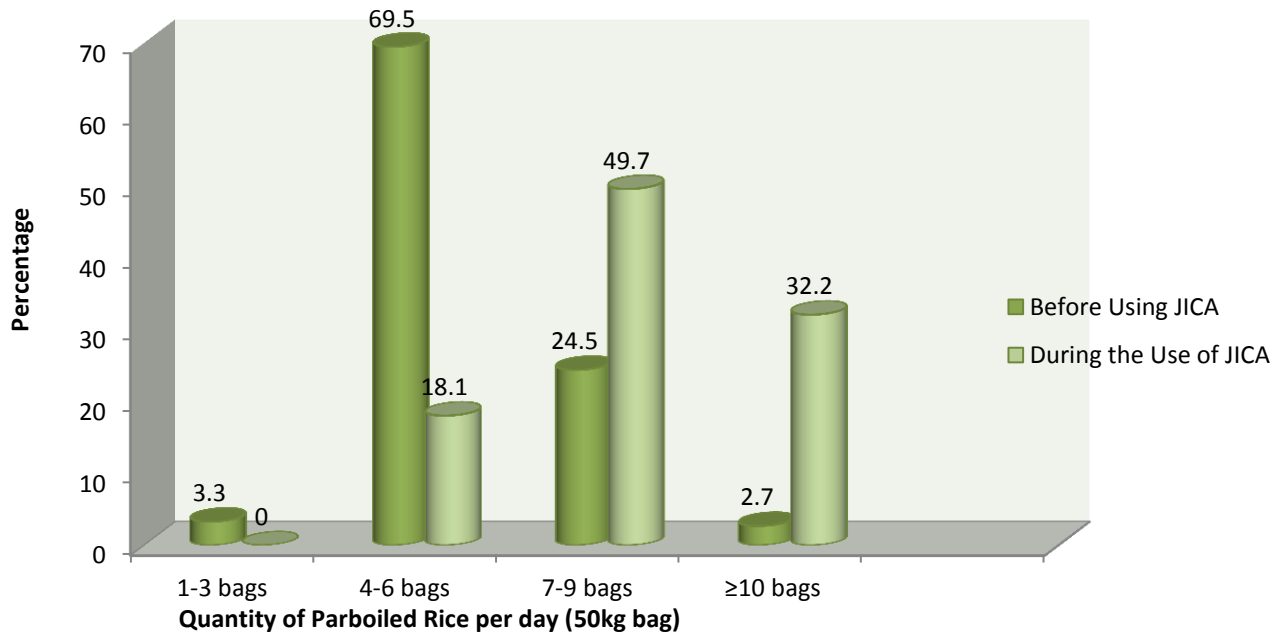

Figure 1. Estimated quantity of rice paddy parboiled weekly before and during the use of JICA improved rice processing technologies
Source: Field Survey, 2021

3.4. Perceived effectiveness of JICA improved rice processing technologies

As shown in Table 3, the beneficiaries of JICA rice processing technologies rated the effectiveness of the technologies introduced by JICA when compared with their previous experience in using the conventional processing practices. Results show that most (98.3%) of the respondents indicated JICA rice soaking method was highly effective in soaking paddy rice. The traditional method involves pre-soaking in fresh cold water overnight before boiling in hot water for several hours to crack, thus taking between 16 and 24 hours to complete one batch. Sometimes, paddy is not soaked at all, but washed and par-boiled at once. The process of soaking recommended by JICA involved leaving

paddy in warm water for few hours before parboiling. Heat some water. The water for soaking is heated until some discernible bubbles appear. The temperature of mass of paddy and water in the container at that time would be in the range of 65°C–70°C. Then, the fire is put out and soaking starts. Pour the paddy into the heated water or the water into the paddy. Leave the paddy to soak in 8 to 10 hours. After soaking, the moisture content of paddy would range from 30% to 35%. It is recommended that this process is conducted in the evening so that other processes can resume in the morning of the following day. The process by JICA helps the processors to ultimately achieve quick and uniform water absorption which is the main objective of soaking. Several studies have

maintained that the soaked paddy should attain a moisture content of about 30 - 35% for proper solubilization and this should takes about 36-48 hours of cold water soaking (Ituen and Ukpakha, 2011; Champathi Gunathilake, 2018). According to Ituen and Ukpakha (2011), hot water soaking has been found to be very effective in the par-boiling paddy because it reduces the soaking time from about 36 hours to about 3 hours. Thus larger production of processed rice can be achieved within a short time. In hot water soaking, water and heat are added to the rice simultaneously. The rate of solubilization increases rapidly because of the increased temperature. The water requirement in the hot water soaking is smaller than in the cold water soaking because frequent changes of soak water are not necessary (Kwofie and Ngadi, 2017).

Results further showed that majority (99.4%) of the respondents indicated that the use of JICA-Rice parboiling method (False Bottom technology) was highly effective in achieving quality rice grain. Unlike the conventional methods of parboiling paddy rice In Nigeria and elsewhere in West Africa which involve boiling the paddy instead of steaming it which results in dark coloured rice, no use of lid, hence steam

goes out leaving the paddy at the top undercooked resulting in breakage at milling (RIPMAPP, 2016; Danbaba *et al.,* 2019), the false bottom technology act in a way that its separate water and paddy while the lid keeps steam inside. This leads to shorter steaming time and whiter colour. When the temperature is even in terms of uniform circulation of steam, it leads to even colour and whiter rice.

Furthermore, Most (97.8%) indicated that milling method of JICA was highly effective to achieve clean whole grains while greater proportion (80.6%) of the respondents indicated that de-stoner introduced by JICA was effective in separating stone from rice grain. These findings showed that respondents' opinion on the JICA processing technology were effective and have contributed to improve to the production of quality rice production in Kogi state. The processors faced several challenges to produce quality rice because the processors still do not appreciate new technology (Nwachukwu *et al.,* 2020). As a result, the demand for better quality imported rice had been increasing steadily over the last two decades (Okeke and Oluka, 2017).

Table 3. Perceived effectiveness of JICA improved rice processing technologies

JICA Improved rice processing technologies	Not Effective Freq. (%)	Mildly Effective Freq. (%)	Effective Freq. (%)	Highly Effective Freq. (%)	Mean	Remark
JICA rice soaking method	-	-	3 (1.7)	177 (98.3)	3.98	Effective
JICA- Rice parboiling method (False Bottom technology) to achieve quality paddy rice.	-	-	1 (0.6)	179 (99.4)	3.99	Effective
JICA- Milling method (Ajifa mill) to achieve clean whole grains.	-	-	4 (2.2)	176 (97.8)	3.98	Effective
JICA-De-stoner at de-stoning	-	4 (2.2)	145(80.6)	31 (17.2)	3.15	Effective

Source: Field Survey, 2021

Result of the analysis on Table 4, shows a mean difference of 0.64 which implies significant difference in the output level of rice processors

before and while using JICA Improved Rice Processing Technologies (sig. = 0.000 < 0.05 at 95% level of significance). The rice processors

had increase in level of output as a result of the utilisation of JICA improved rice processing

technologies.

Table 4. Result of Paired Sample T-test Analysis on difference in the output level of rice processors before and during the utilisation of JICA improved rice processing technologies

	Mean (tons)	Mean Difference	Standard Deviation	Standard Error Mean	t-stat.	df	Sig. value
Before the use of JICA technologies	2.32	0.64	0.631	0.048	-13.196	179	.000
Using the JICA technologies	2.96		0.828	0.62			

Source: Field Survey, 2021

4. Conclusion and Recommendations

Based on the findings, it was found that rice processors are still relatively young, married females. Information on JICA technologies are largely being disseminated through the extension agents and it was found that the use of false bottom at parboiling quality paddy rice, speed of false bottom at parboiling quality paddy rice, JICA rice soaking method, Ajifa mill at milling clean rice grains with good appearance ware all effective methods of rice processing.

In conclusion, JICA improved rice processing technologies are well-disseminated by extension agents to the processors; and empirical evidence from this study showed that not only do processors understand the methods, but they correspondingly accept the utilization of the technologies. The study therefore recommended that free adult literacy classes should be encouraged and organized by local government authorities so as to increase processors' knowledge and orientation towards the use of JICA processing activities. In addition, mass media should be used in disseminating the messages so that processors in other areas will become more conversant with the JICA technologies, thereby increasing utilization for increased agricultural production and food security.

Authors' Contributions

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