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Research Article

Adoption of Improved Rice Processing Technologies: a Case of Small-Scale Rice Processor Groups under IFAD- Value Chain Development Program in Niger State

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Abstract

The study assessed the adoption of improved rice processing technologies focused on small-scale rice processors groups under IFAD- Value chain development program in Niger State. A multi-stage sampling procedure was used for the selection of 160 rice processors. Data were generated using a structured questionnaire. The study used descriptive and inferential statistics analysis of the data. The results showed that 52% of the respondents were between the age of 31 and 40 years; 65.63% of the respondent had between 5 and 15 years of experience in rice processing. The adoption index of rice processing technologies indicated that the paddy cleaning and drying technique recorded 68.75% and 50.0% of the respondents in high adoption category respectively. Parboiling practices and de-stoning had recorded 58.75% and 71.88% of the respondents in medium adoption category respectively, while rice milling operation had recorded 61.25% of low adopters. Tobit regression results indicated that gender was positively significant (P≤0.1); cost of the technology was negatively significant (P≤0.01); while the training (P≤0.01) and social capital (P≤0.05) were positively significant factors influencing the adoption of the rice processing technologies. The study recommends that capacity building (trainings) should be consistently conducted for scaling up the skills and knowledge of the rice processors. The rice processing technologies should be supplied at low-cost within the financial reach of the processors; plus, extension contact and advisory services should be regular and timely to ensure continuous adoption of the technologies extended under the IFAD-VCDP intervention.

Keywords: Adoption, Processor groups, Processing, Technologies, Value chain development program

Introduction

Food commodity processing is an integral part of the value chain that makes the processing industry a viable economic enterprise contributing to economic growth, food security and income generation for households. Rice processing enterprise is witnessing a remarkable change in modern and improved technologies adoption to meet consumers' preference and global export market needs. The volume of milled rice is approximately 507.87 million metric tons worldwide in 2021 (Statista, 2022).The volume is projected to increase by 25.5% in the 2023 – 2024 cropping year. In Africa Sub Sahara, milled rice is expected to increase by 15.3% and in Nigeria by 20.3% owing to extension services and distribution of

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processing facilities to small-scale processor groups (Statista, 2022). The annual milled rice production in Nigeria is approximately 2 million metric tons, which mostly occurs at the cottage by the small-scale processors and their cooperative societies (Ibitoye *et al.*, 2014). The largest growth was recorded in 2010; when the rice crop volume experienced a 26% increase compared to previous years as a result of technology adoption (Ibitoye*et al.*, 2014).

In some countries, rice processing consists mainly of de-husking and sometimes polishing the grains to give appeal to consumers. In most other countries, especially Asia and West Africa, rice is parboiled before milling. Rice processing is of two categories: primary and secondary processing operations. The former is paddy parboiling which include soaking, steaming and drying, while the latter is entirely rice milling and packaging. Parboiling has value-added benefits; it improves the nutritional status of the milled rice, because vitamins and minerals are retained in the kernels. Parboiling mends cracks in the rice, which reduces breakage and improves the milling yields; it changes the cooking characteristics of milled rice; provides resistance to storage insect pests (Poritosh *et al.*, 2011).

Several traditional methods of rice processing have been in existence before the advent of improved methods. The processing is traditionally carried out by pounding in mortal with a pestle; beating with clubs on the floor; rubbing on the floor; threading under the feet of men or hooves of animals. The improved method encompasses the use of modern rice processing facilities and techniques, which include the cleaning and parboiling using false bottom technology. In sequence, drying (tempering and drying under the sun), milling (de-husking, de-bran) and de-stoning (removal of stones, rocks, pebbles and sands) are the techniques (IFAD, 2016).

The IFAD- value development program intervention (VCDP) identified potentials in Nigeria for rice enterprise, but needs a value chain approach to leverage the maximum advantage of rice production and processing as well as market linkage. The agency identifies six pilot states in Nigeria, namely; Anambra, Benue, Ebonyi, Niger, Ogun and Taraba through IFAD and Federal Government of Nigeria (FGN) intervention to enhance productivity, promote agro-processing, access to markets and opportunities to facilitate improved engagement of farmers' organizations. The intervention activities engaged several rice processors who are organized into groups (Farmers Organizations) to readily access inputs such as improved seeds, agrochemicals, and fertilizers as well as training on innovative techniques of rice processing (Adika *et al*.,2017). The small-scale rice processors are strategically profiled, comprising a maximum of 25, or at least, 15 people in a group. The groups are supported with improved technologies, trained on modern practices of rice processing, and linked with off-takers and the input market, among others (IFAD, 2015).

Rice processing is enhanced by the regular adoption of appropriate technologies, especially under the IFAD-VCDP. Low adoption of the improved methods contributes to low quantity and poor output of milled rice (Danbaba *et al*., 2013). This study, therefore, chooses to assess the adoption situation of the processor's groups to contribute to knowledge by making available empirical information for policymakers and providing direction as to which interventions are to be appropriately focused. The earlier studies by (Ibitoye, 2014), (Ajala and Gana, 2015) and Omoare and Oyendiran (2017) provided descriptive information about the processors, but scantly detailed the level to which the rice processing technologies were adopted by the processors. It is against this background that the study seeks to achieve the following objectives: describe the socio-economic characteristics of the processors; identify the levels of adoption of the improved processing technologies; determine the factors influencing the adoption of the processing technologies in the study area.

Materials and Methods

Study Area

Niger State is in the Guinea Savannah Zone of Nigeria. The state is bordered to the North-West by Kebbi State to the South by Kogi State to the South-West by Kwara State. Kaduna state and the Federal Capital Territory, Abuja borders the State to the North-East and South-East respectively. It lies between Latitude8^0 10'N and 11^0 30'N, longitude $6^0$20'E and $9^0$03'E. (Ojohomon *et al.*, 2006). Niger State has 25 Local Government Areas (LGAs). Agriculture is the main occupation of the people in the State. The people mostly involved in crop production (rice, maize, guinea corn, tree and tuber crops), livestock rearing and fishery. The people also engage in other economic activities such as trading, artisan and micro economic businesses. Niger state projected population at 28.5% growth rate for the year 2019 stands at 6,366,367 (UNPFA, 2019).

A three-stage sampling procedure was used for the study. Three local Government Areas (LGAs), namely: Katcha,Wushishi and Kontagora were purposively selected based on the high presence of rice processors groups who are actively involved in rice processing activities in the state. This was followed by a random selection of four rice processors' groups in each of the three LGAs making a total of 12 rice processor groups. Finally, 65% of the members of each of the groups' were proportionately sampled to arrive at 160 rice processors who constituted the sample size for the study **(Table 1)**.

Primary data were collected by using a structured questionnaire comprising a mix of open and closed-ended questions. Print materials and accessible internet stuff were consulted for the empirical information. Focal persons of IFAD-VCDP in the rice processing communities were contacted for easy location of the sampled respondents.

Data were analyzed using both descriptive and inferential statistics. The level of adoption of rice processing technologies was determined by computing the adoption index (AI) of the processors using a procedure adapted from Abubakar *et al.* (2019).The procedure categorized processors into low, medium and high levels of adoption depending on the score obtained on a 0 - 1 score scale. The index was scaled to arrive at categorizations as follows: a score of 0 implies non-adoption, 1 means all the practices have been adopted. 0.1 – 0.33 implies low adoption, 0.34 – 0.66 for medium adoption and 0.67 – 1.0 as high adoption index. The study focuses on the five most prevalent technologies being used by the processor groups under the IFAD-VCDP structure. These are paddy cleaning, parboiling, drying, rice milling and de-stoning. The descriptions of the rice processing technologies chosen for the study are provided in **Table 2**.

Adoption index is specified as:

$$AI_i=\sum_{i=1}^{n}\left[\frac{\frac{Pcai}{Pci}+\frac{Pbai}{Pbi}+\frac{DyAi}{Dy}+\frac{Rmai}{Rmi}+\frac{Dsi}{Dsi}}{N_P}\right]$$

Where i = 1, 2, 3, 4, n, and n = total number of processors.

AI = adoption Index of i^{th} rice processors.
Np_i=number of practices recommended.
Pca_i= adopted paddy cleaning practices
Pc= paddy cleaning practices recommended
Pba_i= adoptedparboiling technologies
Pb_i = recommended parboiling technologies
Dya_i = drying techniques adopted
Dy_i= recommended drying techniques
Rma_i = rice milling operations adopted
Rm_i = recommended rice milling operations
Dsa_i = de-stoning techniques adopted
Ds_i = recommended de-stoning techniques

The factors influencing the adoption of rice processing technologies were determined using Tobit multivariate regression model. The model estimates linear relationships between variables when there is either left-or-right –censoring in the dependent variable. The model describes the relationship between a non-negative dependent variable and an independent variable (or vector) (Richard *et al.*, 2013). The model supposes that there is a latent (that is, unobservable) variable y_i^* which linearly depends on x_i via a parameter β which determines the relationship between the independent variable x_i and the latent variable y_i .$Y_i^* = \beta X_t + \mu_{t.}$ The dependent variable can either be left-censored, right-censored, or both left-censored and right-censored, where the lower

limit or/and upper limit of the dependent variable can be any number.

$$y_i^* = \begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^* & \text{if } 0 < y_i^* < 1 \\ 1 & \text{if } y_i^* \geq 1 \end{cases} \quad (t = 1 \ldots\ldots N) \quad (1)$$

Here, 0 is the lower limit and 1 is the upper limit of the dependent variable. Adoption occurs when y_i falls within $0<y_i^* < 1$ and non-adoption occurs when $y_i^* \leq 0$. The highest threshold or upper limit of y_i is 1 and the lowest threshold in this case is 0. Thus, the final operational multivariate Tobit analysis of factors influencing the adoption level of rice processing technologies is specified as:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 - - - - \beta_n X_n - - - - - \quad (2)$$

Where Y_t^* captures level of adoption by the small-scale rice processors.

The subscript X(s) are the independent socio-economic and institutional variables and β (s) denotes parameter estimates.

The model is superior over other econometric models, such as Ordinary Least Square (OLS), and dichotomous regression models, such as probit, and logit regression for estimation of adoption in that the observed range of the dependent variable is censored in some ways, and the model can be easily extended to handle truncated and other non-randomly selected samples. The model was used in several adoptions of improved agricultural technologies (Adesina and Zinnah, 1995; Bamire *et al*., 2002; Richard *et al*., 2013 and Abubakar *et al*., 2019).

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Results and Discussion

Table 3 describes the socio-economic characteristics of the small-scale rice processors under the IFAD-VCDP in the study area. The result shows that 52.50% of the respondents were between the age of 31 and 40 years. This age range could be regarded as the economically active age group in which most of the processors put their best in the processing business (Basorun, 2013).The finding is related to that of Adejoh *et al*. (2017) who reported 35 years as the average age of farmers participating in the IFAD Commodity Value Chain Program in the Federal Capital Territory, Abuja, Nigeria.

Gender is an important variable of demographics in social research. Contextually, gender is to provide idea about sex divide among the processors. The result indicates 84.37% and 15.63% account for female and males in the rice processing groups. The result conforms to earlier finding by Fumilola (2017) who reported that the VCDP is both male and female gender inclusive. The result implies that women processor in IFAD-VCDP intervention outnumbered the men counterpart. This is consonance with the submission by Danbaba *et al.*(2013) who reported 92.5% of rice processors are women, probably indicating that rice processing is seen as women's trade. The result reveals that 63.75% of the respondents were without formal education even though 18.75% and 13.12% had primary and secondary education respectively. In describing the labour force available for rice processing activities, the results show 66.25% of the respondents have between 10 and 20 individuals in their households who were directly involved in the activities of rice processing. The finding is line with Omoare and Oyendiran, (2017) who observed that large household size is believed to provide cheap labor that will assist in activities of rice production and processing. This implies that labour availability isn't a limitation to carrying out rice processing activities in the study area. Again, most necessarily is the experience, which is a form of knowledge and skills (cognitive and psychomotor) that facilitates rapid embracement of new ideas and innovations. Broadly, it is the frequency of exposure to events and or activities from which an individual or group gather knowledge, idea and skills. The result reveals that 65.63% of the respondents had between 5 and 15 years of experience in rice processing. Impliedly, the more experienced the processor the better is likely to be informed about improved techniques of rice processing and the more conversant is likely to be with activities of the interventions. This is in tune with Kosheri (2016) who reported that processing experience matters more than merely the age when it comes to assessment and performance monitoring of intervention program, especially on rice processing. The finding also reveals that rice farming and processing is the

major occupation for 71.88% of the respondents. It reveals that 32.50% respondents engaged in fishing as their minor occupation and complementary means of living. In the same vein, 6.25% of the respondents choose livestock and poultry farming as their minor source of sustenance. The result is in agreement with Hassan (2018) who submitted that about 45.2% of small-scale rice processors engaged in income diversification activities as minor occupation, by and large multiple stream of income added their capacity to afford processing equipment and expensive machines as well as maintenance.

Level of adoption of rice processing technologies

Table 4 describes the level of adoption of rice processing technologies. Paddy cleaning is an important operation that precedes parboiling. The result indicates 68.75% of the respondents are under high adoption category of the paddy cleaning. It signifies that there was high adoption of the paddy cleaning techniques by the small-scale rice processors under the IFAD-VCDP initiative.

Parboiling is a logical sequence of operations involving soaking and steaming using false bottom parboiling technology. Results in Table 4 indicate that parboiling techniques recorded 58.75% of the respondents who are under medium adoption category. It implies that a slightly half of the sampled population are at medium adoption level of the parboiling technique. Obviously, the parboiling technology, especially the false bottom requires skills and knowledge as well as financial incursion couple with constant guidance and monitoring by extension services to meet the expected outcome. This finding agrees with submission by Omoare and Oyendiran (2017) identified high adoption of improved parboiling techniques (soaking and steaming) using false bottom implement among rice farmers in both Ogun and Niger States. However, much similar to the finding by this study, Kosheri (2016) reported 53.72% medium adoption of the parboiling false bottom technology among women rice processors' groups in Katcha Local Government Area of Niger State.

Paddy drying is next in the sequence to parboiling activities of rice processing. If rice is not well dried it results to broken head rice recovery during milling operation (NCRI, 2016). The result reveals that 50.0% of the respondents are found under high adoption category, while 21.87% and 28.13% of the respondents are under medium and low adoption category respectively. This implies that majority of the rice processors profiled under the VCDP intervention had skills and knowledge to comply with the drying techniques. It follows that majority of the processors find drying techniques relatively better, hence the adoption at high level in the study area. If drying practices are properly carried out, high recovery of milled rice quality would be achieved (NCRI 2016).The finding corroborates the report by Omoare and Oyendiran (2017) who found that adoption of improved drying techniques was reasonably high above average among rice processors' groups. Therefore, it appears that they would be more willing to embrace other technologies in sequence to achieve a complete cycle of rice processing.

Rice milling operation comprises removal of husks and bran (de-husks and de-bran) as well as polishing of the kernel to make it edible and attractive. Result in Table 4 indicates that 61.25% of rice processors were found in low adoption level of improved milling operations, only 18.75% were in high adoption category. This is in disagreement with Adika *et al.* (2017) who concluded that improved milling technology was adopted by a very few therefore recoded 25.7% low adoption level. The finding also contradicts Kosheri (2016) who revealed that 42.75% of small-scale rice processors are in high adoption category of improved rice mill jointly owned by processors' groups and women co-operatives. The modern milling removes drudgeries and wastages associated with local milling practices.

De-stoning is the removal of stones and foreign particles contained in rice grain after mill. The IFAD-VCDP intervention introduced the mini de-stoning machines to the processors' groups under an incentivizing arrangement of matching grant contributory model. The results in Table 4 revealed that 71.88% of the respondents are in

medium adoption category of the de-stoner. By this result, it implies that de-stoning operation had become popular and adopted so as to achieve high quality and stone free milled rice. The high level compliance could be attributed to significant influence of training attended and social capital. Simply put, Kosheri (2016) and Omoare and Oyendiran (2017) stated that quality rice grain can be stocked with high market value, if the aspect of de-stoning is been properly handled by the processors. Stone free quality of milled rice remains a point of strong sensory attraction to off-takers and consumers in the market.

Factors influencing adoption of rice processing technologies

Table 5 shows the result of tobit regression analysis estimating the influence of factors influencing adoption of rice processing technologies by the small-scale rice processor groups under the IFAD-VCDP in Niger State.
The log likelihood function indicates a chi-square value of 503.54 and 0.01 significance level. It suggests that the tobit regression model as whole fits significantly with goodness of fit and strong explanatory power of the model. In other words, all explanatory variables included in the model jointly influence the outcome (independent) variable. That is, the independent variables jointly, were able to model the decision of the processors in the adoption of the improved rice processing technologies. The R^2 value of 0.8564 implies that the variables included in the model accounted for 85 percent of variation in adoption of rice processing technologies introduced by the IFAD-VCDP. Each regression coefficient shows the extent of influence exerts by independent variable on the dependent variable.

Gender was modeled as a categorical variable measured on nominal scale. The variable represents both men and women involved in rice processing. The variable was positive and statistically significant at 10% probability level ((P≤0.10). This implies there is gender inclusiveness with respect to the adoption of rice processing technologies among the respondents in the study area. That is, both male and female can adopt the technologies regardless of the gender differences. By this result, it can be inferred that collective adoption decision can be taken by both men and women since they are bonded in the same processor groups, which invariably leads to more adoption than when only men is left with authority to decide. The finding disapproves the earlier report by Adika *et a*l(2012) who pointed out that rice processing is well suited only to the females gender , and re-affirms that men are conditioned to engaged in production activities to make essential contribution to the agriculture and rural enterprise..

Cost of the technology was modelled as a continuous variable measured in naira amount expended on the purchase of technologies over a year. The variable negatively related to the dependent variable at 1% significant level. The negative relationship implies low cost of technology, and it is capable of influencing the rate of adoption of improved rice processing methods among the groups. The result is in consonance with a review by Agwu and Ibeabuchi (2015)) that farmers are rational in choices of technologies considering the cost factors. The decision of adopting technology often favors low cost technologies, which is always a reality with the small-scale farmers.

Experience is fundamental to the successful optimization of technology usage. Table 5 indicates that experience is positively and significantly ($p\leq 0.05$) related to adoption of the rice processing technologies. It implies that the more years of experience in rice processing the more the tendency of increased level of adoption among the processors. In the same way, as the processors add more years in rice processing, more knowledge and skills are accumulated thereby contributing to adoption of the technologies. The finding aligns with Abubakar *et al*. (2019) who reported positive and significant influence the years of experience have on adoption of agricultural technologies.

Extension contact is an institutional factor modeled as the number of times the respondents

have been visited with extension messages in the last six month. Table 5shows that extension contact positively and significantly ($p \leq 0.05$) related to adoption of the rice processing technologies. It signifies that an additional unit in number of extension contact will lead to corresponding increase in probability of processors to adopt the processing technologies. This finding is in tune with Tiamiyu *et al*.(2010) and Abubakar *et al.* (2016) who observed that extension services have positive effect on the overall decisions to adopt technologies. Simply put, the adoption of rice improved practices increased with an increase in number of extension visits to targets (farmers, processors etc).

The income variable was significant ($P \leq 0.01$) and positively related to adoption of rice processing technologies. This implies that income had a strong influence on decision to adopt technologies. It suggests that an increase in income generated from rice processing activities will increase the probability of the processors to adopt more processing technologies, hence the strong influence on adoption. The finding suggests that, the processors with relatively high income would be at better financial advantage to procure the needed processing equipment for adoption, since using some of the machines has financial implication. This can be judged from standpoint of Akinbode and Bamire (2015) who submitted that the more the income of a farmer, the more money is available to acquire inputs for adoption of improved technologies. Also,Ugwumba (2013) and Ibitoye (2014) reported that farmers with high income because of their privilege position to acquire production inputs would be more willing to adopt more number of technologies and accept higher risk than low income earners.

Social capital is a form of interaction among people in formal or informal associations. It is a network of relationship among people who agreed to work together to achieve a common goals in terms of economic and social development. The variable was positive significant at 5% level of significance. It can be inferred that social capital, which means being a membership of an association, cooperatives, groups and clubs has contributory influence on the adoption of improved processing technologies. The finding aligns with Abubakar *et al.* (2016) who revealed that social capital is a critical factor responsible for the adoption of improved agricultural technologies. Virtually, the social capital places peoples on a ground benefits including cash supports, input supply, access to credit facilities and marketing of commodities at good price .

Training attendance was modeled as a number of times the respondents attended capacity building training on rice processing techniques over last two years. The variable positively and significantly related to adoption of rice processing technologies at 1% ($P \leq 0.01$). This implies that training provided by the IFAD-VCDP intervention has a strong contributory influence on the adoption of the technologies among the processors. This can further be inferred that the more number of training attended by the processors the higher the rate of adoption of processing technologies, as training provides capacity buildings in terms of technical skills and knowledge. The result is in agreement with Ibitoye (2017) who reported positive and significant influence of training participation on adoption of processing technologies among small-scale rice processor in Bassa Local Government Area of Kogi State, Nigeria. Similar results were reported by Abubakar *et al* (2019) who revealed that training was found with significant and positive direction of relationship with technology adoption. Usually, trainings on all aspect of the rice processing technology are provided to group of individuals who in turn, as a matter of responsibility, would organize step-down trainings to others.

Conclusion and Recommendations

The study concludes that the small-scale rice processors are in active age (between 31 and 40 years) and possessed adequate years of experience in rice processing. The processors' group is gender inclusive though dominated by women folk. Paddy cleaning and drying recorded 68.75% and 50.0% adopters respectively under

high adoption category, while parboiling using false bottom technology and de-stoning recorded 58.75% and 71.88% adopters under medium adoption category. The rice milling (de-husking, de-bran), however, recorded 61.25% low adopters. The study further concludes that trainings, years of experience, low-cost of technologies; extension contact and the income were the estimated factors that influence the adoption of the processing technologies extended by the IFAD-VCDP initiatives. Therefore, the study recommends that capacity building (trainings) should be consistently conducted for scaling up the skills and knowledge of the rice processors. The rice processing technologies should be supplied at a low-cost within the financial reach of the processors; extension visit and contact should be regular and timely to ensure continuous adoption of the technologies extended under the IFAD-VCDP intervention.

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Table 1: Sampling plan

Selected LGAs	Selected rice processors' groups in the Participating IFAD-VCDP LGAs	Number of rice processors in the groups*	Selected 65% of the total number of rice processors in each of the groups.
Katcha			
	EbogiNnawutotlo	25	16
	Nagenu CMPs	20	13
	Ebosoko CMPs	23	15
	EnaMisungu FO	20	13
Wushishi			
	Rogotakomina Allah	15	10
	Kanko Hikma FO	23	15
	Adalchimatakanko	20	13
	Dabiri CMPs	15	10
Kontagora			
	T/wada South	23	15
	Rahama CMPs	25	16
	Adarawa FO	15	10
	Farinshige FO	22	14
Total			**160**

Source: *IFAD VCDP Coordinating Office, Minna (2019).**Niger State Chapter of RIPAN, (2019)

Table2: descriptions of rice processing technologies selected for the study

Rice processing technologies	Description of the processing practices
Paddy cleaning	A technique for separating weeds, straws, foreign mater, sands and debris through winnowing, sieving and washing of the paddy
Parboiling	Use of false bottom for soaking and steaming. It has two tanks made of galvanized sheets. One serves as boiler while the other serves as steamer which contains perforated crate placed on false bottom. The water inside the boiler is heated for 2 hours to allow temperature of $75 – 80^0$ C depending on the rice variety. Paddy must attain optimum gelatinization (when70% of aggregate paddy split open). Parboiling must stop immediately at that point
Drying	Is the gradual reduction of moisture content of steamed paddy to about 12 – 14%. Constructed drying slab for paddy drying aids getting free from dirt and foreign particles. Tempering is when drying is temporarily stops to enable moisture within the grain equalizingdue to diffusion. Rake is used for spreading the paddy to ensure thin layer.
Milling	Is a machine operates to remove the husk(de-husking) and the bran layer (de-bran) and polishing. Milling should result in 2.5% husk, 8-12% bran .
De-stoning	Mechanical operation using the de-stoning machine to remove stones, pebbles, chaff and solid rocks and foreign particles. . depending on the capacity, but averagely can de-stone 10 -12 tons/day..s

Table 3: Distribution of respondents according to socio-economic characteristics (n=160)

Variable	**Participant (n= 160)**		**Mean**	**SD**
	Freq	**%**		
Age (years)				
< 20	6	3.75		
21 - 30	34	21.25		
31 - 40	84	52.5	34.62	45.356
41 - 50	26	16.25		
>50	10	6.25		
Gender				
Male	25	15.63		
Female	135	84.37		
Level of education (years)	**Freq**	**%**		
Non formal	102	63.75		
Primary	30	18.75		
Secondary	21	13.12		
Tertiary	7	4.38		
Household size				
< 10	34	21.25		
10 – 20	106	66.25	13.02	17.56
>20	20	12.50		
Processing experience (year)				
<5	5	3.12		
5-15	105	65.63	**9.06**	15.43
16 – 26	40	25.00		
>26	10	6.25		
Major occupation				
Rice processing	115	71.88		
Livestock / poultry farming	10	6.25		
Fishing	28	17.50		
Civil service	2	1.25		
Trading	5	3.12		
Minor occupation				
Rice processing	45	28.13		
Livestock / poultry farming	23	14.37		
Fishing	52	32.50		
Artisan	26	16.25		
Trading	14	8.75		

Source: field survey, 2019

Table 4: Level of adoption of the rice processing technologies by the small-scall processors under the IFAD-VCDP processor groups (n=160)

	Adoption score categorization		
Improved Rice processing technologies	1.01 – 033 (low adoption)	0.34 – 0.66 (medium adoption)	0.67 – 1.0 (high adoption)
Paddy cleaning	15 (9.38)	35 (21.87)	110 (68.75)
Paddy parboiling	56 (35.00)	94 (58.75)	10 (6.25)
Drying	45 (28.13)	35 (21.87)	80 (50.00)
Rice milling	98 (61.25)	32 (20.00)	30 (18.75)
De-stoning	25 (15.62)	115 (71.88)	20 (12.50)

Source: field survey, 2019. Figures in parenthesis are percentages

Table 5: Result of tobi regression model showing estimates of factors influencing adoption of rice processing technologies by processors under VCDP intervention

Variables	**Coefficient**	**Standard error**	**t-ratio**	**P>|z|**
Gender	.0966251	.0529595	1.82	0.070*
Level of education	-.0026373	.0019794	-1.33	0.185
Cost of technology	-.0014984	.0005161	-2.90	0.004***
Processing experience	.0321364	.0147759	2.17	0.031**
Extension contact	.0136049	.0023932	5.68	0.000***
Annual income	8.65e-07	2.99e-07	2.92	0.007***
Social capital	.0140356	.0065666	2.14	0.040**
Training attended	.063791	.0135983	4.69	0.000***
LR chi^2 (15) = 503.54				
Prob> chi^2 = 0.0000				
Log likelihood = 163.62649				
Pseudo R^2 = 0 .8564				

Source: field survey, 2019. ***Significant at 1% level. ** Significant at 5% level * Significant at 10% level.