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WILLINGNESS TO PAY FOR VALUE-ADDED SOLID WASTE MANAGEMENT SYSTEM AMONG CASSAVA PROCESSORS IN NIGERIA

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ABSTRACT

Cassava (*Manihot esculenta* Crantz) is one of the most important staple food crops processed and consumed in different forms in Nigeria. Environmental pollution from solid waste increases with increasing production and processing of cassava. Past studies showed that over 55% of waste produced from cassava processing are disposed in dumping sites, creating both environmental pollution and negative health impact on the population in the neighborhood of cassava processing facilities. Improved waste management systems for making value-added products such as mushroom, feed and organic manure from cassava waste hold promise for environmental preservation and income generation for the smallholders. A survey of 403 cassava processing enterprises was carried out using structured questionnaires to identify different forms of cassava waste management systems and potential benefits to adopters of various forms of improved management systems. Descriptive statistics, contingent valuation and Logit model based on the cumulative probability function were used to determine the willingness of the processors to pay for improved waste management system and analyze the factors influencing processors' willingness to pay. Women constitute largest population of smallholder cassava processors and generate largest amount of cassava solid wastes. The mean willingness to pay for acquiring new knowledge on improved waste management technologies was US$3/person. However, more than half of the respondents were willing to pay for acquiring new knowledge on the improved waste management, while other were on willing though they showed great level of interest in acquiring the new knowledge. It is expected that public expenditure to empower processors to use technologies for converting cassava solid wastes to value-added products will lead to lower cost and higher social benefits to the population (lower exposure to toxins and additional income to the smallholders, less pollution of the air, rivers and underground water, etc) compared to the current waste disposal methods.

Key words: Cassava, pollution, smallholders, solid waste, value-added, willingness to pay.

INTRODUCTION

World production of cassava is estimated at over 250 million tonnes, with Nigeria being the world's largest producer (Asante-Pok, 2013). In Nigeria, cassava is mostly produced and processed by small-scale farmers at the family or village level. In addition it provides different opportunities for both men and women, from the production stage till it get to the final consumer. The technology of processing cassava roots involves primarily, peeling, grating, fermenting, de-watering, frying, drying etc. Each of the processing stages produces some waste. The type and composition of the waste depend on the processing method and type of the technology used (Osunbitan, 2012). The waste from cassava is organic in nature and it is composed of both solid and liquid waste. Discarded tuber peels forms the first stage of the solid waste from cassava. Subsequently, when the flesh of the cassava tubers are grated and dewatered, wastewater is obtained. Furthermore, after dewatering, the resulting cassava semi-solid mass is then sieved, and the ungrated fibers (chaff) are then discarded as the final solid waste (Olukanni *et al.,* 2013). Waste products resulting from cassava processing are often inadequately disposed causing a foul smell and unattractive sight, more than 60% of the rural population in Nigeria is engaged in cassava-based cottage industries and millions of tons of cassava waste are produce from such industries (Eze, 2010). Management of waste varies across various processing centers in the country, over 55% of waste produced from cassava processing are dispose in dumping sites, while only few cassava processors makes benefit from the waste they produce (Sackey and Bani,

2007). Mostly cassava peels are either abandoned nearby the processing site, used for land filling and/or burnt thereby posing serious threat to the environment and heath hazed to processor. Based on forgone, the study therefore examined the waste management systems in use by cassava processors and their willingness to pay for value-added solid waste management system. The study further examines the factors that may influence the processors' willingness to pay for value added waste management system.

STUDY AREA AND METHODS

This study was carried out in the forest and savannah zones of Nigeria. These zones span across the southern and North-central states of Nigeria, three states were chosen based on their high level of cassava production and processing. The states of Edo, Kwara, and Ogun were thus chosen for the study. The study makes use of primary data which was collected using a well-structured questionnaire. For the study, 450 questionnaires were administered however 403 were found usable due to incomplete responses from the respondents

Descriptive statistics was use to analyze socioeconomic characteristics and cassava processors' waste management system in use this includes frequency distributions and percentages. A logit model based on the cumulative probability function was adopted to determine the mean willingness to pay for added solid waste management system by processors and factors influencing processors 'willingness to pay because of its ability to deal with a dichotomous dependent variable. The approach for this model will follows the model adopted by Yusuf *et.al*, (2007).

$$y = \frac{1}{1+e^{-(\beta 0+\beta 1Xi)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Y_1 = is the respond of processors' willingness to pay for value-added solid waste management system question which is either 1 if yes or 0 if no

$\beta 0$ = constant

$\beta 1$ = coefficient of the price processors' willingness to pay for value-added solid waste management system

x= the prices that the processors gave for value-added solid waste management system

The Mean willingness to pay for improved solid waste management system by smallholder cassava starch processor was calculated using the formula adopted by Yusuf *et al.,* (2007) given as;

$$\text{MeanWTP} = \frac{1}{\beta_1}\ln(1 + \exp\beta_0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

To assess the factors influencing willingness to pay for improved improved solid waste management system by processor , the processor responses to the WTP question which is 1 if yes and 0 if no will be regressed against socioeconomic characteristics of the processor. The regression logit model is specified as:

$$Y = \frac{1}{1+exp^{-z}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where Y = is the respond of processors' willingness to pay for value-added solid waste management system question which is either 1 if yes or 0 if no

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots\ldots\ldots\ldots\ldots + \beta_nX_n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Y = Willingness to improved waste management training, X_1= Gender (1= male, 2= female), X_2= Household size (number), X_3= Quantity of cassava processed (kg), X_4= Years of experience (years), X_5= Years of education (years), X_6= Member of association (1=Yes, 0=No), X=Awareness of value-added solid waste management system Dummy variable (yes =1, no=0)

RESULT

The result showed that majority (68.73%) of the respondent are female processors, this indicates that woman are more into cassava processing. The mean age of respondents in the study is 48 years which implies that majority of the respondents are in their active working age. Majority of the processors are educated with approximately 7 years as average year of education. The mean household size of the respondent approximately 6 members per household. Majority (83.33%) of the processors own their own processing center and 56.95% of them source for funds from

their personal pocket. In term of scale of operation of processors study shows that majority (62.28%) processed between 1-10 tonnes of cassava in a month.

Waste produced from cassava processing centers are peel and chaff, these wastes have to be managed because of the pollution it causes to the environment. Processors make use of one or more waste management practices in their processing center. Four solid waste management practices in use were indentified in this study, these are dumping, giving out free, selling wet waste and selling of dry waste.59.55% of the processors dumps part or all the waste produce from their processing center, 58.06% of the processor give out part or all the waste out freely while 27.79% sells the waste wet as they produced it from their processing center. Only 35.48% of the processor take a step further to dry waste and sell.

The study also showed that 61.79% of the processors are willing to pay for the training on converting cassava waste to organic manure while 56.33% of the processors are willing to pay for the training on production of mushroom from cassava waste. The Mean WTP is a nonlinear function of model parameter (Yusuf *et.al.*, 2007). The estimated mean WTP for the training on production of mushroom from cassava waste was N504.63 ($3) and N159.15 ($1) for the training on converting cassava waste to organic manure. The mean WTP is positive for both trainings; this implies that the processors are willing to pay for the trainings. The considerable low means WTP can be attributed to the lack of awareness on benefit of the training. In addition most processors interviewed think that going into production of these cassava peels products will consume a lot of their time, and make them deviate from their main processing activities

Table 1: Mean willingness to pay

Mean willingness to pay training on organic manure				
Variable	**Coff.**	**Standard Error**	**z-statistics**	**Prob.**
Constant	-1.74716	0.23299	-7.50	0.000
Price	0.00108	0.00014	7.73	0.000
Degree of freedom = 1, Log Likelihood = -162.09761, Pseudo R2 = 0.3952, Chi2 (LR Statistics) = 211.87, Significance Level = 0.000, Mean willingness to pay = ₦159.15				
Mean willingness to pay training on production of mushroom				
Variable	**Coff.**	**Standard error**	**z-statistics**	**Prob.**
Constant	-1.16313	0.183497	-6.34	0.000
Price	0.000503	0.000067	7.48	0.000
Degree of freedom = 1, Log Likelihood = -208.61642, Pseudo R2 = 0.244, Chi2 (LR Statistics) = 134.97m Significance Level = 0.000 , Mean willingness to pay = N540.63				

The factors affecting the willing to pay for training on production of mushroom, table 2 shows that the model is significant at one percent. Pseudo R^2 of 0.12 implies that about 12% of total variation in processors willingness to pay for training on organic manure is explained by combination of seven exogenous variables. A log likelihood of -240.24 implies that the observation explains the model. Processors WTP have a marginal effect of 0.57 which implies that a unit change of all the variables will affect processor WTP for the training by 57%.

With respect to gender of processors, there is positive relationship with WTP for the training, the relationship is significant at 10%. This implies that being female increase the likelihood of being WTP for the training by 13%. A unit increase in the number of household size will increase the likelihood of being WTP for the training by 3%, is significant at 10%. Awareness of new management system will increase the likelihood of being WTP for the training by 32.5%, is significant at 1%. An increase in the years of education of processors will increase the likelihood of processor's WTP for the training by 6%, significant at 10%. With respect to quantity of cassava process by processors, there is negative relationship with WTP for the training, the relationship is significant at 1%. This implies that a unit increase in quantity of cassava process will decrease the likelihood of being WTP for the training by less than 1.

Factors affecting processors willingness to pay for training on organic manure shows that the model is significant at one percent (table 2). Pseudo R^2 of 0.185 implies that about 18.5% of total variation in processors willingness to

pay for training on organic manure is explained by combination of seven exogenous variables. A log likelihood of -218.36 implies that the observation explains the model. Processors WTP has a marginal effect of 0 .654 which implies that a unit change of all the variables will increase the processor WTP for the training by 65.4%.

With respect to gender of processors, there is positive relationship with WTP for the training and significant at 10%. Being female increases the likelihood of being willing to pay for training in organic manure production by 13.5%. A unit increase in the household size also increases the likelihood of being willing to pay for this training by 3.3%, significant at 5%. Awareness of new management system will increase the likelihood of being WTP for this training by 42.2%, is significant at 1%. An increase in the year of education of processors will also increase the likelihood of being WTP by 8.6%, significant at 10%. However, there is a negative relationship between being willing to pay for the training on organic manuring and quantity of cassava processed. A unit increase in quantity of cassava process will decrease the likelihood of being willing to pay by less than 1% and this is significant at 5%.

Table 2 : Factors influencing willingness to pay for training

Variables	Coeff OM	P-value OM	Marginal effect OM	Coeff MP	P-value MP	Marginal effect MP
Gender	0.598*	0.020	0.135	0.531*	0.029	0.130
Household size	0.144**	0.008	0.033	0.121*	0.018	0.030
Quantity of cassava processed	-4.65e-5**	0.001	-1.05e-5	-6.01e-5***	0.000	-1.47e-5
Years of experience	-8.5e-4	0.948	-1.9e-4	-0.004	0.761	-0.001
Year of education	0.051*	0.049	0.011	0.037	0.128	0.009
Member of association	-0.388	0.110	-0.086	-0.160	0.483	0.392
Awareness of new management sys	2.087***	0.000	0.422	1.401***	0.000	0.325
	LR chi2 (7) = 99.66 Prob>chi2=0.0000 PseudoR2=0.186 Log likelihood= -218.20 Marginal effect after logit Y=0.6536			LR chi2 (7) = 71.72 Prob>chi2=0.0000 PseudoR2=0.13 Log likelihood= -240.24 Marginal effect after logit Y= 0.5696		

***significant at 1%; ** significant at 5%; * significant at 10%.

OM- organic manure; MP- mushroom production

Conclusion

The study examined the willingness to pay for value added waste management systems among cassava processors in Nigeria. The study shows that the waste management systems presently in use by the cassava processors are dumping, giving waste freely, selling wet waste and selling dry waste. Furthermore, two value added cassava waste management system (organic manure and production of mushroom) were introduced to the cassava processors and more than half of the processors studied are willing to pay for the value added waste management. Therefore, based on the findings of this study, it is recommended that training on value added should be subsidized in a bearable manner so as to encourage and enable more participation of cassava processors. There should be sensitization on benefits of the new waste management systems and on the value added products to aid marketing of the products from the waste to the general public.

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