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Urban Farmers' Willingness to Pay and Utilize Urban Waste for Agriculture in Akwa Ibom State, Nigeria

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Abstract Recycling of urban waste for use in agriculture can satisfy the household demand for food, reduce poverty, food insecurity and improve employment opportunities. This study investigated the factors influencing the willingness to pay for urban waste recycling for agriculture by urban farm households in Akwa Ibom State, Nigeria. The survey used cross-sectional data which was obtained from ninety (90) urban farm households that were randomly selected from three major cities in Akwa Ibom State and analyzed using descriptive statistics and Tobit regression. The result showed that the average age of the respondents was 50 years, the mean educational level and years of farming experience were ten (10) and nine (9) years, respectively. Also, the mean monthly expenditure, farm size, and household size were ₦ 59,010, 0.8ha and about 8 persons, respectively. In addition, socio-economic factors such as educational status, monthly expenditure, land acquisition method and household size positively and significantly influenced households' willingness to pay for urban waste recycling. Conversely, age had a negative and statistically significant influence on households' willingness to pay for recycling and use of urban waste for agriculture. Policies aimed at upgrading educational level of the urban farm household, promoting land ownership, encouraging youth farmers and creating income-generating programs in the area are recommended.

Keywords: *agriculture, urban waste, recycling, willingness to pay, organic farming*

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1. Introduction

The last two decades have witnessed an increasing demand to not only producing large quantities of food but to also achieve development towards sustainable agriculture, where production is simultaneously economically beneficial, socially fair and environmentally friendly. There has been a worldwide resurgence of interest in urban food production, reflecting increased recognition of the need to invest in environmentally friendly agriculture. Additionally, the recurring food shortages and rising food prices in cities have increased a surge in interest in urban farming among urban dwellers. Urban farming is now seen as an innovative and spontaneous response by the poor urban dwellers to reduce poverty and food insecurity problems. Studies [1,2], observed that there is a continuously growing interest in the practice of urban agriculture as reflected in its essentiality as a priority research and policy issue on the international development agenda. Urban agriculture could be a cost-effective means of enhancing food security if the waste generated in cities could be efficiently recycled and use as organic fertilizer.

According to [3], Urban agriculture can be defined as "an industry located within or on the fringes of a town, a city or a metropolis which grows and raises, processes and distributes a diversity of food and non-food products, (re)using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and materials resources, products and services largely to that urban area". Urban agriculture reduces the distance between where food is produced and where it is consumed. It includes a variety of agricultural activities such as subsistent farming, beekeeping, food-producing green roofs, aquaculture, and private gardens.

Given the rapidly growing world urban population and expansion of industries, especially in developing countries, the volume of urban waste is rapidly increasing, and its composition is becoming more and more complex, leading to increased pollution and waste disposal problems in many cities. In collaboration, [4] asserts that rapid population growth, widespread poverty, inadequate and weak local governance and limited financial resources all contribute to the waste management problem.

However, the use of organic waste for agriculture has been increasingly recognized in recent past. Recycling and re-use of organic wastes generated by cities, including

compost and appropriately treated sewage are increasingly feasible in many cities of the developing countries. The utilization of urban waste has many benefits, some of which are: improvement of soil structure, thereby reducing erosion; supply and conservation of nutrients in the soil and solution to the waste management problem associated with urban waste disposal.

The most important urban waste which can potentially be recycled for agricultural purposes is sewage sludge, compost, and by-products of the food and beverage industries. The public sewage system is not popular among the inhabitants of the three major cities in Akwa Ibom State. A combination of septic tanks and soakaways are used by households to dispose of their household sewage. This provides a Sustainable Urban Drainage System (SUDS) with low environmental impact. Organic waste from both large-scale food processing and subsistent food processing, such as cassava processing, yam processing, Champion breweries, can also be used in agricultural production. The efficiency of recycled urban waste used for agricultural production can be estimated by the rate at which its Nitrogen (N-fraction) becomes available, and its Carbon to Nitrogen (C/N) ratio.

The recycled sewage is denoted as an N-P fertilizer, meaning that it is rich in Nitrogen and Phosphorus, but poor in Potassium. This ratio is highly dependent on the recycling method. [5] showed that sludge applied properly, could significantly improve the yield of Ipomea Aquatic. According to [6], sewage sludge has the additional benefit of increasing microbial biomass and activity, however, the use of recycled sewage may be accompanied by the detrimental effect of the introduction of heavy metal into the soil.

The recycled compost is denoted as an N-P-K fertilizer, which means it is rich in varying percentages in all three elements. Compost is the most widely accepted organic fertilizer, especially mature plant compost, and those obtained from poultry farm wastes. Poultry farm waste is particularly widely accepted because it is mixed with sawdust, relatively inexpensive, and easy to apply. However, [6] assert that compost generally has low soluble N-content, which typically is in the range of 0-10%. However, the N-content available increases as the farmer continue to apply compost yearly.

Recycling of urban waste for agricultural use in the Metropolitan areas of Akwa Ibom State, Nigeria.

A concerted effort to manage waste and utilize it for agricultural effort will both require key policy changes and investment in infrastructure. The need to recycle this urban waste which is rich in Nitrogen, phosphorous, and Potassium for use in enriching and promoting urban farming has been identified by policymakers as a high priority. This study attempts to answer the question on the keenness of urban farmers in the three urban centers in Akwa Ibom State to adopt organic fertilizers and their willingness to pay (WTP) for the recycling of urban waste for their use.

Potential contamination of farmlands is the major concern of urban farmers when asked to use recycled urban waste in their farms. The farmers are concerned about future liabilities and possibility of contamination of foodstuffs. This is a legitimate concern since recycled waste can contain a significant amount of heavy metals like Cd, Zn, Ni, and extraneous materials like glass and plastics. Thus, it is necessary to develop a legal framework for use of urban waste in Akwa Ibom State to ensure that heavy metals and extraneous materials are kept below the legal limits.

2. Materials and Methods

2.1. Study Area

The study was conducted in Akwa Ibom State in Nigeria, with a population of about 3. 92 million [7]. The State is a major oil-producing area and is located in the South-South geopolitical zone of the country, lying between latitudes 4°32' and 5°33' N and longitude 7°25' and 8°25' E. It shares its southern boundary with the Atlantic Ocean. The State has a very rich potential for agriculture and is suitable for food and tree crops, fish and livestock farming. Crops widely grown in the area are leafy vegetables such as waterleaf, fluted pumpkin and garden egg. Others include cassava, maize, yam, pepper, plantain, garden egg and cucumber. The State comprises three major urban centers namely: Eket, Ikot-Ekpene, and Uyo, with agriculture being the main local employer. Also, urban farming is being practiced by some households (mostly the low-income group).

2.2. Data Collection

A structured interview questionnaire was used for data collection. Because the study was on Urban Agriculture, three major urban areas in the State were purposively selected (Eket, IkotEkpene, and Uyo). Through the assistance of the city council, a list of urban farmers in each town was compiled, from which fifty (50) urban farmers were randomly selected from Uyo, 20 urban farmers each from Eket and Ikot-Ekpene town, all in proportion to the population of registered urban farmers in the cities. The interviewers attended a 1-day training workshop before the study to familiarize them with the process and prepare them to answer any question the farmers may pose. The heads of each household were interviewed in the 3 selected urban centers. The questionnaire included demographics, education, income, farming experience, farm size and household size. The interviewers proceeded with the interview by first asking the respondents whether they consented to participate. If the answer is, yes, they are then encouraged to sign an informed consent form. Of the selected 90 households, a 100% positive consent rate was achieved.

2.3. Data Analysis

The data collected were analyzed using descriptive statistics such as mean, and standard deviation and inferential statistics such as Tobit regression model. In determining the socio-economic factors influencing the respondents' willingness to pay (WTP) for recycling and/or reuse of organic waste for agriculture, maximum likelihood Tobit regression model was used. The Ordinary Least Square (OLS) would be inefficient and inconsistent as it does not tolerate the presence of zeros in its error term.

The Tobit model is specified thus:

$$Y^* = \beta^1 X + \varepsilon$$

$$Y = \begin{cases} 0, Y^* \le 0, Y^* < T \\ 1, Y^* > 0, Y^* \ge T \\ Y = Y^* \ otherwise \end{cases} \quad (1)$$

$$Z^* = \alpha 1V + u$$

$$Z = \begin{cases} 1, Z^* > 0 \\ Z, Z^* \le 0 \end{cases} \quad (2)$$

Where Y is a vector of WTP that is censored at 0; T is the offered start price; X is matrix of explanatory variables that are hypothesized to influence WTP; Z is a vector of a dummy variable which is 1 when a respondent is willing to pay and 0 otherwise; is a matrix of explanatory variables that may influence the probability that a respondent is willing to pay; α and β are vectors of unknown parameters to be estimated corresponding to the matrix of explanatory variables V and X, respectively; ε and u are error terms that could be correlated with correlation coefficient P; and Y* and Z* are unobserved or latent variables corresponding to Y and Z, respectively. Y values are observed when z equals 1.

3. Results and Discussion

The summary statistics of some explanatory variables are shown in Table 1. The Table showed that the mean age of the respondents was about 51 years, suggesting that the respondents were still in their fairly active and productive age. The mean years of formal schooling were about 10 years, indicating that on the average, the respondents had at least primary education. The average years of farming experience were about 9 years, this shows that the respondents were very experienced and therefore conversant with the problems of farming in the study area. The mean monthly expenditure was ₦ 59,010 an indication that on the average, a typical urban farmer earned above the national minimum wage rate of ₦18, 000 per month. The mean farm size was 0.839 ha suggesting that majority of urban farmers practiced subsistence farming. The mean household size was about 8 persons. This implies that the household size was greater than the recommended national average household size of 5 persons in Nigeria.

Table 1. Summary Statistics of the continuous variables

Variables	Mean	Std. Dev.	Min	Max
Age	50.9778	10.9298	33	75
Education	10.9333	3.4079	6	18
Farming Exp.	9.2111	7.1320	1	40
Monthly expenditure	59010	25718.58	18000	145000
Farm size	0.839	0.52444	0.15	3
Household size	7.8444	2.5656	2	15

Field Survey: 2016.

Factors influencing willingness to pay for recycling and use of urban waste for agriculture in Akwa Ibom State.

The Tobit model was significant at the one percent level of probability ($p < 0.01$) with log likelihood ratio of – 429, 71347. Given this goodness of fit measure, it can be concluded that the Tobit model used is reliable and has requisite explanatory power. Five out of nine variables fitted into the model were statistically significant. The variable such as the age of the respondent had a negative and significant ($p < 0.01$) coefficient. This shows that the likelihood of a farmer willing to pay for waste recycling reduced with an increase in age. This implies that older farmers were not willing to pay for recycling of organic waste for urban agriculture in the area.

Level of education is one of the most important factors in awareness and willingness to pay for innovations. Educational status had a positive and statistically significant ($p < 0.05$) relationship with willingness to pay for urban waste recycling and/or use for agriculture. This implies that education provides knowledge and makes the household get information and the information creates awareness about the benefits obtained from the recycling of urban waste for use in agriculture. It could also mean that higher years of educational attainment leads to higher willingness to pay for recycling of urban waste for agricultural use. This result is consistent with the findings of [8,9,10].

Also, household expenditure (a proxy for income) was positively and statistically significantly related to the probability of a farmer willing to pay for waste recycling. A plausible explanation for this result is that households with high incomes are more likely to pay for waste recycling than low-income households. It could also mean that a proportionate increase in income will lead to a more than a proportionate increase in farm households' willingness to pay for urban waste recycling in the study area. This results also shows the general demand theory which states the positive relationship between income and demand for goods. This result lends credence to the findings of [11].

The coefficient of land acquisition was positive and statistically significant ($p< 0.05$), suggesting that the likelihood of paying for urban waste recycling increased among households who are landlords as compared to tenants or those renting farmland for agriculture. Also, household size had a positive and significant ($p < 0.01$) coefficient, indicating that the likelihood of willing to pay for reuse and/or recycling of urban waste for agricultural purposes increased with bigger household size. Perhaps, bigger household sizes mean many mouths to feed and reuse of urban waste will reduce the high cost of buying inorganic fertilizer, hence, producing more food to feed the household at a reduced cost. In addition, households with a large number of family members perceived that the output (production) obtained using recycled urban waste can support the large family members via increasing the supply of enough food to the household. [11] had similar findings.

Table 2. Tobit regression analysis on Factors influencing willingness to pay for recycling and use of urban waste by farmers in Akwa Ibom State, Nigeria

Explanatory Variables	Coefficient/Std. errors	Z- values	Marginal effects (dy/dx)
Intercepts	807.8355 (6949458)	1.16	
Gender (X_1)	-29.5092 (272.9879)	-0.11	-29.5092a (272.99)
Age (X_2)	-62.5007 (10.5555)	-5.92***	-625007 (10.556)
Marital Status (X_3)	148.1236 (331.0171)	0.45	148.128 a (331.02)
Education (X_4)	56.3972 (27.0638)	2.08**	56.3972 (27.064)
Farming Experience (X_5)	22.5250 (13.9048)	1.62	22.5250 (13.905)
Monthly Expenditure (X_6)	0.01087 (0.00371)	2.93***	0.00371 (0.325197)
Land Acquisition (X_7)	472.5613 (174.78)	2.70***	472.5613a (174.78)
Farm Size (X_8)	107.6704 (151.7809)	0.71	107.6704 (151.78)
Household Size (X_9)	117.3758 (33.1118)	3.54***	117.3758 (33.112)
Goodness of fit measures			
Prob > Chi^2 = 0.000			
Log likelihood ratio = -429.71347			
LR Chi^2 = 93.86			
Pseudo R^2 = 0.0985			
Sigma = 661.9327 (69.06651)			
Number of observations = 90			
*** = Significant at 1 % level of Probability			
** = Significant at 5 % level of Probability			
(a) dy/dx is for discrete change of dummy variable from 0 to 1			

Source: Field survey, 2017.

4. Conclusion

In this paper, we have estimated the willingness of urban farmers to pay (WTP) for waste recycling, in three major cities in Akwa Ibom State, Nigeria by means of Tobit regression. Urban waste can be a valuable resource for improving food security in Nigeria and other developing countries; however, if the urban waste is not harnessed through recycling or other disposal methods, it can lead to waste management problems and the consequential environmental/health issues. Recycling urban waste for agriculture will help in the achievement of the Sustainable Development Goals (SDGs) 1, 2 and 12 of ending poverty in all its form everywhere; end hunger, achieve food security and improve nutrition and promote sustainable agriculture as well as to ensure sustainable consumption and production patterns.

The major finding of this work is that age, education, monthly expenditure, land acquisition method and household size significantly influenced urban farmers' willingness to pay (WTP) for waste recycling and use for agriculture in the study area. We also discovered a disparity in WTP based on educational attainment, this points to the need of awareness campaign to boost farmer's knowledge of the benefits of organic fertilizers and the potential hazards of mismanaged urban waste. Also, youth should be encouraged to own land in urban centers as well as picking up farming as a career this is because the older generations are not willing to pay for waste recycling.

This work can help policymakers make informed estimates on how much government subsidy and mass education is required to implement urban waste recycling in the study area. We are also proposing the establishment of Centers of excellence in urban waste recycling and management in Akwa Ibom State.

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