Waste Management 29 (2009) 3047–3051

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Factors influencing waste separation and utilization among households in the Lake Victoria crescent, Uganda

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ARTICLE INFO

Article history:
Accepted 3 August 2009
Available online 8 September 2009

ABSTRACT

Wastes, which are the by-products of consumption, are a growing problem in the urban and peri-urban areas of the Lake Victoria region largely due to high urban population growth rates, consumption habits, low collection rates and hence waste accumulation. Whereas the biodegradable proportion is high and could be reutilized, a few have tapped the economic potential of this waste. This study was conducted to explore the potential alternatives and determinants of waste separation and utilization among urban and peri-urban households in the Lake Victoria crescent. A random sample of households in five urban and peri-urban areas of the crescent were selected and surveyed. Logit models were used to establish the factors influencing waste separation and utilization in urban and peri-urban areas of the lake crescent. Results indicate that, gender, peer influence, land size, location of household and membership of environmental organization explain household waste utilization and separation behaviour. Campaigns for waste separation and reuse should be focused in the peri-urban areas where high volumes of wastes are generated and accumulate. Social influence or pressure should be used to encourage more waste reuse and separation.

1. Introduction

The management of crop waste is a big problem in the growing urban areas of the Lake Victoria crescent, Uganda. This is largely due to increasing urban population and consumer demand for foodstuffs marketed in raw form. This means that the task of processing is carried out by the final consumer (households) within the urban and peri-urban centres resulting in accumulation of waste products. A survey by Sendawula et al. (1997) of five markets around Kampala city found that wastes were mainly organic based mixed with plastics, polythene bags, and broken bottles, thus limiting their utilization.

Although wastes have been utilized elsewhere as mulch, feed for livestock (Allison et al., 1998; Asomani-Boateng and Haight, 1999; Hofmann, 2005) and in biogas production, very few people in the Lake Victoria crescent region, Uganda have tapped this economic potential. Studies have indicated that crop wastes are potential sources of nutrients for improving soil fertility (Sendawula et al., 1997) and livestock productivity (Nambi, 2001). Some households in the Lake Victoria crescent region sort household wastes and apply the organic fraction to gardens. However, these sorted waste streams are in small quantities compared to what is accumulated in many urban and peri-urban areas. This study was therefore aimed at exploring potential alternatives of crop waste utilization and assessing the determinants of waste separation and waste utilization[1] in urban and peri-urban areas of the lake crescent region.

2. Methodology

The study was conducted in the main urban and peri-urban areas of the five districts of Kampala, Mukono Mpigi, Masaka and Iganga, which are located in the Lake Victoria crescent of Uganda (see Fig. 1 for location of study districts). The districts supply fresh crop produce sold in the urban and peri-urban markets that generate much of the crop wastes.

A total sample of 577 households from the main urban and peri-urban areas of each district was drawn using random sampling methods with the help of the local council officials in each urban area who are familiar with the locality. The local councils served as the primary sampling units. A list of households drawn from each selected local council acted as the sampling frame. Random numbers were then assigned to each household and the final sample drawn. This sample comprised of 44% from Kampala city, 22% from Masaka urban area, 12% from Iganga urban area, 10% from Mpigi urban area and 12% from Mukono urban area. Variations in

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[1] In this paper, waste utilization and separation relates specifically to the biodegradable crop waste fractions and not any other wastes.

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doi:10.1016/j.wasman.2009.08.001

Fig. 1. Map of Uganda showing the study districts.

the final sample were principally due to differences in sizes of the urban population residing in each of the selected urban areas as reported by 2002 population census.

The data collected comprised: socio-economic characteristics of the respondents, utilization of various waste components, household member responsibilities in terms of waste management; quantities of wastes generated, types and quantities of wastes utilized, reasons for limited or non-use of wastes and problems associated with waste utilization.

3. Data analysis

The determinant factors for crop waste separation and utilization among urban and peri-urban households was analysed using logistic regression models and Stata software. This is due to the binary nature of the dependent variables (Greene, 2003). Following Park et al., (2002) and Oskamp et al. (1991), a household was assumed to make a decision to separate and reuse garbage based on the perceived costs and benefits accruing to it. Factors that are hypothesised to directly or indirectly influence waste reuse behaviour were modelled as a function of four sets of variables. These included socio-economic characteristics, behavioural attitudes, peer influence and institutional arrangements.

The logit model used can be explicitly specified as

$$\ln\left(\frac{P_i}{(1-P_i)}\right) = \sum \beta_i x_i$$

where P_i is the probability that the respondent reuses waste or probability that respondent segregates waste, β_i are the coefficients that were estimated and x_i are the explanatory or behavioural variables. These are presented in Table 1 together with their expected signs.

4. Results and discussion

Results show that the majority (60%) of the respondents in the sample were males and three quarters of the households were male headed. There was no significant difference (t-value = 0.533) between the mean age of respondents in urban (40.2 years) and peri-urban (39.4 years) locations. This implies therefore that

Table 1
Description of variables used in the crop waste analysis.

Variables	Expected sign
Age of the household head in years	+ or −
Education of household head in years	+
Income level on a scale of 1–11 (1 = less than 100,000, 2 = 101,000–200,000, 3 = 201,000–300,000, 4 = 3001,000–400,000, 5 = 401,000–500,000, 6 = 501,000–600,000, 7 = 601,000–700,000, 8 = 701,000–800,000, 9 = 801,000–900,000, 10 = 901,000 to 1 million, 11 = over 11 million shs)	+
Gender of household head (1 = male, 0 = female)	−
Household size	+
Plot or land size of respondent (acres)	−
Membership of environmental or agric organization (1 = member, 0 = otherwise)	+
Ownership of land or plot (1 = owned, 0 = otherwise)	+ or −
Attitude towards composting or waste reuse (1 = whether respondent considered it as laborious, 0 = otherwise)	+
Environmental concern (1 = very concerned, 0 = not concerned)	+
Peer influence (1 = if household had friends or neighbours or family members who reused waste, 0 = otherwise)	+
Location of respondent (where 1 = urban, 0 = peri-urban)	−
Total crop waste generated in kg	−

respondents of all ages reside in either location. The mean household sizes were significantly different at 5% between the urban and peri-urban areas. Peri-urban households comprised of seven members on average compared to five members for urban areas. This has implications on waste generation levels in the two areas with peri-urban households generating more wastes.

There was a significant difference at 1% in time spent on waste management activities per day by urban and peri-urban households. Peri-urban households on average spent 24 min per day on waste management activities compared to 18 min per day spent by the urban households. This is far higher than that reported by Bennagen et al. (2002) in Manila who found that households on average spent 75 min per week (10 min per day) on waste management. There was a significant difference at 1% in the quantity of crop wastes generated per week by urban and peri-urban households. Peri-urban areas on average generated 24 kg of waste per household compared to 16.5 kg per household per week in urban areas. Peri-urban residents generated more wastes than their urban counterparts probably due to the concentration of agricultural activities in these areas as well as their consumption of fresh unprocessed foodstuffs.

Waste sorting is a crucial step in ensuring that wastes generated are reused. However, results show that the majority of respondents (73%) never practiced any sort of waste separation at all, while only 37% sorted all crop wastes. The most sorted crop wastes comprising matooke (banana peels), potato peels, cassava peels and vegetable remains. The motives for waste separation included: commitment to a clean environment (46%), use as compost/mulch material (10%), for sale (31%) and for use as livestock feed by the peri-urban farmers (6%).

The separation and use of household crop waste materials are usually "win–win" situations. This is because wastes are sold for extra cash, fed to livestock, generate employment while reducing quantities collected by the city authorities and disposal costs. However, the contamination of urban organic wastes by other materials limits reuse. For households that never sorted waste, the majority (46%) cited time constraint as the major factor while 36% had not thought of sorting of wastes at all and viewed it as useless.

Due to their organic nature, the wastes generated have great potential for reuse thereby limiting their accumulation and consequently the health and the environmental problems that could arise. Results show that presently, over 50% of the respondents dumped the crop wastes generated in their garbage bins with no further use thereafter. Approximately 40% of the respondents fed these wastes to livestock. The most used waste for this purpose was matooke peels. This is profitable as shown by WAREN project in Metro Manila where profits more than doubled by feeding pigs on organic scrap feeds (CAPS, 1992). However, the level of waste sales by the respondents was relatively low with less than 10% of the respondents doing this. The most common waste sold was banana peels comprising about 80% of the total wastes sold followed by sweet potato and cassava peels at 14%.

4.1. Factors influencing waste utilization

Results from the logistic regression analysis show that the variables gender, area of the plot, peer influence, ownership of plot and location of the household were significant and explained the probability of waste reuse. Table 2 shows the estimated coefficients for waste utilization model. With respect to overall goodness of fit, the waste utilization model had a highly significant log likelihood score. The McFadden's pseudo R^2 which is one of the measures of the goodness of fit is 0.5025. This means that the independent variables explain approximately 50% of the variability in the household's decision to reuse waste. Other factors not included in the model could explain the remaining variation. The model correctly classified 85% of the observations. The model chi-square is 194.86 with 12 degrees of freedom and is statistically significant at 1% level. The null hypothesis that all coefficients except the constant are equal to 0 was therefore rejected.

Gender of the household head was positive and significant at 10%. This implied that the probability of waste utilization increased if the respondent was a male. However, this was not in accordance with *a priori* expectations given that women are more involved in waste related activities and would have higher probability of reusing them. The probable explanation for this result is that some waste utilization practices require much more muscular effort for example composting, which males could provide.

The area of plot or land size was positive and significant at 5% level. This implies that the larger the plot size, the higher the probability that the individual uses other resources to improve soil fertility. This is plausible because, the bigger the plot size the larger the space available to either practice farming activities carry out waste sorting and store waste materials. Space is particularly a constraint to urban residents due to their small plot sizes.

Membership of environment or agricultural organization had the expected sign and was significant at the 5% level. Based on probability impacts, this increased the likelihood of waste reuse by 24%. Belonging to an environment or agricultural organization can influence one's perception about environmental issues and stimulate actions that promote environmental values. The sharing of knowledge and experiences enhances positive environmental values among members (Oskamp et al., 1991).

The influence of friends and family who reused wastes (peer influence) was equally predictive of the respondents own decision to participate in waste utilization. Peer influence was positive and highly significant at 1%. This is consistent with findings by Park et al. (2002) who found that peer influence increased the probabil-

Table 2
Determinants of crop waste utilization. Logistic regression: dependant variable waste reuse = 1 and 0 = otherwise.

Variable	Coefficient	Standard error	$P > (z$-value)	Marginal effects
Constant	−3.799	3.403	0.264	
Gender of household head	0.788	0.408	0.054*	0.188
Household size	0.0308	0.322	0.924	0.007
Area of plot	0.539	0.217	0.013**	0.129
Environmental concern	−0.337	0.391	0.389	−0.081
Peer influence	4,734	0.666	0.000***	0.793
Membership of organization	1.001	0.405	0.013**	0.236
Age of household head (years)	−0.174	0.182	0.340	−0.001
Education of household head	−0.004	0.053	0.928	−0.001
Ownership of land/plot	0.943	0.479	0.049**	0.210
Income of household head	0.249	0.030	0.412	0.059
Crop waste generated (kg/week)	−0.032	0.218	0.883	−0.007
Location of the household	−1.780	0.547	0.000***	−0.416

Log likelihood = 96.468.
LR chi-square (11) = 194.86.
N = 290.
$P >$ chi-square = 0.0000.
Pseudo R^2 = 0.5025.
Sensitivity = Pr(+|D) 68.10%.
Specificity = Pr(−|∼D) 93.22%.
Correctly classified = 84.83.
* Shows significance at 10% level.
** Shows significance at 5% level.
*** Shows significance at 1% level.

ity of composting by 20%. In this study, it increased the likelihood of waste reuse by 79%.

Location of the household was found to be significant at 1% and negative. The likelihood of waste reuse is higher among peri-urban residents than urban. Peri-urban areas generate more waste than urban areas, are not constrained by space and situated where most farming practices are carried out. Whereas the level of education of the household head was hypothesized to positively influence waste reuse, in this case, it was negative and not significant. This is in contrast to studies by Hong et al. (1993) and Reschovsky and Stone (1994) who found that education increased waste recycling.

4.2. Factors influencing crop waste separation behaviour

Waste sorting has a significant impact on the economic efficiency of household waste management systems as it is an essential part of the reuse process. Results from the logistic regression analysis (Table 3) show that, the variables gender, household size, environmental concern, income, time, ownership of land and total volume of crop waste generated are significant and therefore explained household waste separation behaviour. The model performed well with a pseudo R^2 of 47% and a chi-square significant at 1% level. Overall, the model correctly classified 87% of the observations.

Gender is negative and significant at 10% level implying that the likelihood of waste separation was higher among females. This is expected given the role women play in waste household management activities. Women tend to be responsible for waste work within the household and along with children and domestic workers, may sort and sell recyclable materials. They tend to be more environmentally friendlier than men (Hayes, 2001; Van Liere and Dunlap, 1980). They are the key to controlling waste accumulation

Table 3
Determinants of crop waste separation. Logistic regression: dependant variable: waste sorting (separation) = 1 or 0 = otherwise.

Variable	Coefficient	Standard errors	$P > (z$-value)	Marginal effects
Constant	−6.406	3.792	0.091*	
Gender of household head	−0.796	0.436	0.068*	−0.118
Household size	1.418	0.455	0.002***	0.199
Area of plot	−0.001	0.237	0.99	0.002
Environmental concern	1.065	0.401	0.008***	0.163
Income of household head	0.768	0.346	0.027**	0.108
Age of household head	−0.303	0.362	0.632	−0.042
Education of household head	0.022	0.058	0.695	0.003
Time constraint	−4.539	0.597	0.000***	−0.811
Ownership of land/plot	1.008	0.414	0.015**	0.158
Crop waste generated kg/week	−0.734	0.268	0.006**	−0.103
Location	−2.443	0.573	0.000***	−0.275

Log likelihood = −94.408.
LR chi-square (11) = 166.90.
N = 306.
$P >$ chi-square = 0.0000.
Pseudo R^2 = 0.4692.
Sensitivity = Pr(+|D) 95.98%.
Specificity = Pr(−|∼D) 65.85%.
Correctly classified = 87.7%.
* Shows significance at 10% level.
** Shows significance at 5% level.
*** Shows significance at 1% level.

in households, although they have been ignored by previous studies of waste management systems. This result is in tandem with studies by Beall (1997) and Du (1995) who found women more involved in source separation of wastes than men. Scheinberg et al., 1999 reaffirms this and asserts that women know more about the environment and are responsible parties in handling domestic responsibilities associated with cleanliness.

The time variable had the a priori expected negative sign and was significant at 1% level. Generally, those who perceived time used in waste separation as a constraint had a high opportunity cost of time and were thus less likely to sort the wastes. This is in agreement with a number of studies on recycling behaviour where time is looked at as an important inconvenience factor (e.g. De Young, 1986; Vining and Ebreo, 1990; Oskamp et al., 1991).

Urban respondents were less likely to sort waste compared to their peri-urban counterparts. The coefficient for location had the expected sign and was significant. Lack of space for farming, composting or organic waste reuse makes this plausible. Studies by Gamba and Oskamp, 1994 and Vining et al., 1992 reported that households in crowded urban areas find space a constraint in separation of garbage in cases where storage is necessary.

Environment concern was positive and significant at 5% level. This implied that those who were concerned about the environment were more likely to separate their wastes compared to those who were not. Based on the marginal effects, concern about the environment increased the likelihood of waste separation by 16%. Environmental concern generally tends to force individuals search for solutions to the ever increasing problem of waste in their neighbourhoods. This agrees with the work of Barr et al. (2001) who asserts that active concern incorporates both stated and moral obligations to act appropriately towards the environment and appears to enhance the willingness to do something about it.

The total volume of crop wastes generated was significant in explaining waste separation behaviour. This implies that the more waste a household generated, the less likely it would sort the wastes. This is probably due to high volumes of waste generated being directly related to volume of work or activities generating the waste and thus waste separation is accorded low priority effort. Individuals were therefore less likely to sort the wastes. This is in contrast to work done by Bennagen et al. (2002) in Manila who found that the higher the quantity of wastes a household generated, the higher the probability that it would engage in waste separation.

5. Conclusion and policy implications

The findings in this study show that waste separation and reuse are linked. Peri-urban households generated significantly more waste than urban households did. Waste separation at the household level leads to less contamination of the waste and enhances its reuse either as a feed for livestock or soil amendment. Efforts to promote waste separation and utilization should focus on the peri-urban areas, which generate and accumulate most waste. Source separation could be promoted, using community publicity campaigns targeting peri-urban areas. Attitude towards the environment by households influences waste separation. Therefore, environmental concern in the Lake crescent region needs to be promoted using schemes highlighting the waste problem at hand. Since waste reuse by peers is predictive of households own waste reuse, social influence/pressure could be used as a stimulus to encourage more waste reuse and separation. Savings in disposal costs and land fill space due to waste reuse as well as conservation of resources by waste reuse are benefits which could be realized. Waste separation at the household level needs to become part of a new waste management policy or bye-law to enhance reuse. The involvement of active environmental organizations, women's clubs, church organizations and other associations is necessary. Generally, campaigns should target both men and women due to the complementary nature of their roles with women more likely to carry out waste separation while men provide the labour necessary in waste management activities like composting which requires more physical effort.

Acknowledgements

The authors are grateful to Sida/SAREC-Makerere University Research Program for the financial support provided for this research and the local councils in the five urban and peri-urban areas of the Lake Victoria crescent for their part in mobilising the respondents who participated in this study.

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