Determinants of re-cycling and use of domestic waste in urban swamp areas of Yaounde in Cameroon

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Abstract:

The present paper aims to identify the determinants of the recycling and use of recycled domestic waste in the swamp areas of Yaounde, Cameroon. For this purpose, we identify the determinants of their use in three swamp areas in order to propose a domestic waste strategy among households. Data was collected between August and September 2005 among 126 farmers. Results show that the production of vegetables, the short distance between the house of the farmer and their farm, the use of recycled livestock wastes, the level of education and the surface of the farm have a positive effect on the decision to use domestic waste in the swamp areas of Yaounde. On the other hand, the age of farmers have a negative effect. In fact, the closer the farmers live to their farm, the more likely they will use recycled domestic wastes. To promote good management of domestic waste and safe urban and semi-urban agriculture in the swamp areas, the implementation of transfer station of waste collected, in or next to swamp areas, seems to be a solution.

Keywords: Recycling; Logit model; Domestic waste; Urban and peri-urban agriculture; Transfer station

1. Introduction

Urbanization and economic development generally coincide with an increase in consumption and production of waste per capita (UNEP, 2006). The growth of the urban population and the continual extension of land use will increasingly put pressure on the management and the sustainability of the environment (Harris, 1996; Gunther *et al.*, 1997). In Africa, the problems related to waste production have become crucial as the agricultural production of domestic waste become more and more intensive and near inhabited zones, in particular in urban and peri-urban areas (Keys et al., 2005; Gockowski et al., 2004). This intensification process is also very difficult to control since it is conducted not only in countries where the informal sector recovers large parts of the economy (more than half of the GDP in Cameroon is informal), but also because urban agriculture is mostly practiced by the urban poor (INS, 2004; Ruel *et al.*, 1999). In this context, households and municipalities have to cope with their own agenda of survival or law enforcement. The link between the urban poor and local municipalities is therefore sometimes hard to find.

Household livelihoods and local government constraints can hardly be considered separately. At the household level, urban agriculture is a source of incomes for the urban poor. It involves the growing use of chemicals for higher output and the use of waste materials to lower input costs (Nkamleu *et al.*, 2000). Poor households can hardly be expected to pay for various services such as municipal waste compost (Danso, 2006). But on the other hand, surveys reveal that households from all neighbourhoods in Yaounde put domestic waste disposals and public gardens at the top of their needs (INS, 2002).

At the municipality level, many cities produce waste which is very seldom industrially treated (incineration for example) because of bad governance or lack of funding. Cameroon faces the same problems as Kenya for instance in terms of Municipal Solid Waste (MSW) services: poor servicing, illegal dumping, unplanned settlements from natives or migrants, poor state infrastructures, etc. (Henry, 2006). Only the towns of Yaounde and Douala benefit from a service of waste collection. It is operated by a the *Société Hygiène et Salubrité du Cameroun* (HYSACAM), the only private company providing a public service in charge of waste collection for Yaounde and Douala (INS, 2004). In the rest of the country, the task of collecting waste is under the responsibility of the municipalities.

The population of Yaounde grew from a hundred thousand inhabitants following its independence in 1960, to up to 1.7 million in 2005 (INS, 2004). This urban growth has increased waste production. In urban areas, farmers are gradually substituting gardening and horticultural crops with staple crops. Fruits and vegetables have become the most profitable crops on a receding surface of arable land in urban areas (Parrot *et al.*, 2005; Smith *et al.*, 2004). However, the receding surface available has also imposed intensive practices with chemical products and waste materials. In regards to the continuous increase in population and to maintain or increase the agricultural outputs of their crop fields, farmers will have to secure the richness of the soils with nutritive elements (Gockowski *et al.*, 2002). For the time being, the fertility system in the various urban and peri-urban agro-ecosystems is characterized by a strong utilisation ratio for chemical fertilisers and organic materials (Kouemo, 2002).

Waste materials are ordinary inputs in the traditional agricultural production process. Many processes of natural fermentation allow the recovery and the recycling of organic matter, starting with domestic waste which is the core of our study. Thus, urban and periurban agriculture, through the processing of domestic waste in its natural state as compost (banana peels, hen droppings, liquid pig manure, etc.), play as a filter for the environment, while safeguarding the natural resources of production (Lekane et al., 2003).

According to Ngnikam (2000), the average production of domestic waste in Yaounde is 0.6 kg per capita/per day during the dry season and 0.98 kg per capita/per day during the rainy season. According to Ngnikam (2000) and Sotamenou (2005), between 40 per cent and 43 per cent of domestic waste of Yaounde is collected by HYSACAM, which is in concordance with other studies in Tanzania but less then the 60 per cent in Ghana (Kassim *et al.*, 2006; Asomani, 2002). According to HYSACAM, an average of 700 tons of domestic waste are collected every day in the town of Yaounde, mainly in the districts of the city accessible by trucks. Considering that 51 per cent of households are located next to an unpaved road in Yaounde, the collection of waste is very difficult and vulnerable to rainfalls (INS, 2002). This kind of situation is not uncommon in Africa and it contributes to isolate the urban poor from other districts (Olvera, 2003). Douala, Cameroon's largest city, frequently suffers from ongoing cholera epidemics consequently to such a lack of urban infrastructures.

The aim of this paper is to determine the factors affecting the use of recycled domestic and animal waste in crop fields located in swamp areas and suggest accordingly adequate operations of recovery and recycling in the swamp areas. In a city like Yaounde, swamps are not only a source of nuisance but are also considered as not constructible by the municipalities. However, urban swamps are, as in Zimbabwe for example (Masocha, 2006), one of the most important survival options for the urban poor, especially recent immigrants. Urban and peri urban agriculture in the swamp areas of Yaounde provides significant amounts of fresh agricultural products for the urban population.

Section 2 provides an overview of the data source, Section 3 outlines the dichotomic Logit model, its characteristics and its estimation. Section 4 presents the empirical model specifications, and Section 5 discusses the results. The paper ends in Section 6 with conclusions and recommendations.

2. Data source

The data used in this study was collected between September and August 2005 in three swamp areas of Yaounde. There are a total of twelve swamp areas in the city disseminated along the various rivers crossing the city. These swamps range from downtown to the peri-urban suburbs of the city. According to the National Institute of Statistics in Cameroon, there is no census available, nor any statistical information available for the population living in these areas.

The swamp areas were chosen according to a non probabilistic sampling procedure based on their location, their general characteristics and the general livelihood profiles of the dwellers. Our statistical unit was the household but information was collected at the individual level for all members of the family. Specific information was collected for each farmer and its crop fields.

For the Ekozoa swamp area, the sample consisted of the entire population of farmers. For the two other swamps, a transec census was conducted. Table 1 provides information on the sites of the study.

Table 1: Main characteristics of the three swamp areas of the study

	Nkolondom	Etoug-Ebé	Ekozoa
Size sample	N = 52	N = 43	N = 31
Location	8 to 9 km from downtown	10 km from downtown	Downtown
Degree of tidiness	Clean	Dirty	Relatively clean
Land pressure	Medium	Strong (real estate pressure)	High (squatters)
Crops	Condiments and vegetables	Staple crops	Flowers and vegetables
Farmers problems	Fear of expropriation, increasing urbanisation, decrease in production	Seasonal floods of swamps, fear of expropriation	The marginalisation of farmers in building sites for installation of parks

The swamps of Nkolondom are located between 8 and 9 km away from downtown Yaounde in a more rural environment, with much less land pressure and vegetables as the main source of agricultural income. The swamps of Etoug-Ebe are also in Yaounde (10 km away from Downtown) but surrounded by slums, with strong real estate pressure and staple crop production. The swamps of Ekozoa are located in downtown Yaounde. They were mainly used for floriculture by a non-resident population, with a great risk of expropriation. In 2006, shortly after the survey, most of the 31 farmers of Ekozoa were expelled by the municipality and public gardens have since been constructed in this area.

3. Conceptual Model: The dichotomic Logit model

In order to identify and to analyze the determinants of the use of recycled domestic waste (RDW) in the swamp areas of Yaounde, we estimated two dichotomic Logit models, one for recycled livestock wastes (hen droppings and pig manure) and one for vegetal wastes (recycled fresh or decomposed kitchen waste).

Falusi (1975) used a Probit model to analyze the factors influencing the decision to use manures in Nigeria. Nkamleu (1996) suggested identifying and analyzing the determinants for the adoption of urban compost starting from a dichotomic Logit model, in its study on the determinants of demand for urban compost carried out in the towns of Yaounde and Bafoussam in Cameroun. This study revealed that the poor organization of distribution systems for the compost constituted the main reason for its non adoption; the adoption of compost was a function of the age of the owner, the practice of agriculture, the perception of compost and the size of the household.

The Logit model can be specified as follows:

Let *Z* be the vector of the variables likely to influence the use of the RDW. The use of the RDW by a farmer in the swamp areas of Yaounde follows a utility function $U_1 (Z) = V_1 (Z) + e_1$ and their non-use follows a utility function $U_0 (Z) = V_0 (Z) + e_0$. V_i and e_i respectively represent the deterministic and random components, Z represents the argument.

The rational farmer will choose the option which provides the highest satisfaction utility. The probability that it asks for RDW is expressed as follows:

$$P(Y=1) = P [U_1 > {}_{U0}] = P [V_1 (Z) + e_1 > V_0 (Z) + e_{1]} = P [V_1 (Z) - V_0 (Z) > + e_0 – e_1]$$

By supposing that $V_i = \beta_i Z$, we have: $V_1 (Z) - V_0 (Z) = (\beta_1 - \beta_0) Z$. Therefore, $P(Y=1) = P [\beta Z > e] = F (\beta Z)$ with $\beta = \beta_1 - \beta_{0,}$ the vector of the parameters to be estimated and $e = e_0 – e_1$, the term of error.

$F(\beta Z)$ is related to a cumulative distribution; the Logit model supposes that F follows a logistic function. Under these conditions, the probability that an unspecified farmer asks for RDW will be given by:

$$P(Y = 1) = \frac{\exp(\beta Z)}{1 + \exp(\beta Z)}$$

Consequently, the probability of not using the RDW will be given by:

$$P(Y = 0) = 1 - P(Y = 1) = \frac{1}{1 + \exp(\beta Z)}$$

With « exp » the exponential function.

The dichotomic Logit model was estimated by the method of maximum-likelihood. The Newton - Raphson algorithm was used to approximate $F(\beta Z)$ by a quadratic function from a Taylor series expansion around the unknown value β that maximizes F. Mc Fadden's R^2 is used to evaluate the quality of the adjustments. To solve the problem of multi-colinearity which would make the results unreliable, we carried out a Multiple Correspondences Analysis (MCA).

4. Empirical model

The descriptive statistics of the variables included in the empirical model are displayed in Table . The population of the three selected swamps is mostly composed of non native farmers (*Bamileke*, *Eton*, *Ewondo*) with an average of 12 years of experience in urban agriculture. The size of the households, around five, is in concordance with the national statistics of the country. Women are largely involved (62 per cent) in farming activities in the swamp areas.

Fields are very small (0.05 hectares) for obvious reasons of population densities and land scarcity. Livestock activities are rather relatively common in Yaounde, but not in the swamps for sanitary reasons, or because of lack of income, according to the respondents. More then a third of all respondents have an off-farm activity, which illustrates the close rural-urban linkages between the two sectors.

A total of 68 per cent of farmers purchase organic waste, mainly chicken droppings. Domestic wastes are used in smaller quantities. Most respondents (72 per cent) use approximately the same amount of fertilizers as during the preceding years of the survey, but the use of natural wastes is still a significant share of all fertilizers used (62 per cent of all respondents). Most farmers have attained at least a primary level of education, 50 per cent in Nkolondom, 32 per cent in Etoug-Ebé and 38 per cent in Ekozoa.

The utilisation rate of the recycled domestic waste (RDW) in our three swamp areas is 59 per cent and 75 per cent of farmers of Nkolondom; 55 per cent and 67 per cent of farmers of Etoug-Ebé; 58 per cent and 54 per cent of farmers of Ekozoa. They respectively use the livestock wastes and recovered and recycled fresh and decomposed kitchen waste. The proportion of farmers who use fresh and decomposed kitchen waste in Ekozoa (54 per cent) is lower than the others as it could be expected since only 29 per cent of them live close (less than 500 m) to their fields against 69 per cent and 83 per cent respectively in Nkolondom and Etoug-Ebé.

Table 2: Socio-economic profile of farmers in the three (3) swamp areas of Yaounde

	Swamp areas					
	Nkolondom (N=52)		Etoug-Ebé (N=43)		Ekozoa (N=31)	
	Frequency (Mean) [1]	% of valid observations (Std. Error)	Frequency (Mean) [1]	% of valid observations (Std. Error)	Frequency (Mean) [1]	% of valid observations (Std. Error)
Gender of the farmer (SEX)						
-Men	21.0	40.4%	09.0	20.9%	19.0	61.3%
-Woman	31.0***	59.6%	34.0*	79.1%	12.0***	38.7%
Age of the farmer (AGE)	**(36.4)**	**(10.2)**	**(36.4)**	**(10.8)**	**(34.6)**	**(08.7)**
Size of household (SIZE)	**(05.5)**	**(02.7)**	**(05.3)**	**(02. 6)**	**(04.6)**	**(02.5)**
Level of education (EDUC)						
-No formal education	19.0	36.5%	09.0	20.9%	08.0	25.8%
-Primary school	26.0	50.0%	14.0	32.6%	12.0	38.7%
-Secondary school	06.0	11.5%	14.0	32.6%	08.0	25.8%
-Post secondary	01.0	02.0%	06.0	13.9%	03.0	09.7%
Practice of a non agricultural activity (NONAGR)						
-Yes	16.0	30.8%	18.0	41.9%	11.0	35.5%
-No	36.0	69.2%	25.0	58.1%	20.0	64.5%
Type of VEG practiced (VEG)						
-Vegetables	52.0	100%	40.0	93.0%	06.0	19.3%
-Flowers	0	0	03.0	07.0%	25.0	80.7%
Expenditure in chemical inputs (CHEMEXP) (10^3 Fcfa)	**(75.4)**	**(74.4)**	**(29.0)**	**(33. 8)**	**(60.1)**	**(58.9)**
Distance between the house of the farmer and their farm (DISTHOME)						
Not far < 500m	36.0	69.2%	36.0	83.7%	09.0	29.0%
Far >500m	15.0*	30.8%	07.0*	16.3%	22.0*	71.0%
Practice of breeding (BREEDING)						
-Yes	12.0	23.1%	03.0	07.0%	0	0
-No	40.0	76.9%	40.0	93.0%	31.00	100%
Purchase of recycled livestock wastes used (BUYRLW)						
-Yes	23.0	63.5%	24.0	55.8%	18.0	58.1%
-No	19.0	36.5%	19.0	44.2%	13.0	41.9%
Surface area of the farm (SURFACE)	**(551.0)**	**(421.0)**	**(412.7)**	**(387.4)**	**(687.1)**	**(722.4)**
Use of recycled livestock wastes (USERLW)						
-Yes	31.0	59.6%	24.0	55.8%	18.0	58.1%
-No	21.0	40.4%	19.0	44.2%	13.0	41.9%
Use of recovered and recycled fresh and decomposed kitchen waste (USERKW)						
-Use	39.0	75.0%	29.0	67.4%	17.0	54.8%
-Do not use	13.0	25.0%	14.0	32.6%	14.0	45.2%
Membership of farmer's association (ASSOC)						
-Yes	06.0	11.5%	03.0	07.0%	14.0	45.2%
-No	46.0	88.5%	40.0	93.0%	17.0	54.8%

[1]Numbers between brackets represents the quantitative variables.

*Difference Male – Female significant with the threshold of 1% in Etoug-Ebé and 10% in Nkolondom and Ekozoa.

*Difference Far - Near (Distance separating the residence from the land) significant with the threshold to 1% in our three swamping areas.

We identified a range of variables likely to have an influence on the decision to use the RDW. The explanatory variables retained and used in the estimate of our two Logit models as well as the expected theoretical effects are presented and discussed below.

SEX is a dummy variable that indexes the gender of the farmer taking on the value of 1 if the farmer is male and 0 if female. We expect that the use of RDW will be indeterminate between male and female farmers. Male farmers may have a short term perspective in urban agriculture, whereas female farmers, mostly spouses, may be more involved in it, with less income pressure for the household. Therefore, the expected sign for SEX is indeterminate.

AGE is a variable that measures the age of the farmer. Young people may have a tendency to be the first to adopt a new technology (Bodiguel, 1975). They may also have the physical force to transport the RDW to their land. It may also be linked to the sex of the person. But for the same reasons involved for sex, we believe that AGE is indeterminate.

SIZE measures the household's family size (all members, all ages). When the farmer is a member of a large household, the probability for him to use the waste in their farm is increased.

EDUC measures the educational level of farmers. The educational level of a farmer has a positive influence on the probability of using the RDW, because it understands better the agronomic and environmental advantages related to the use of the RDW.

NONAGR is a dummy variable that indexes the off-farm activities of the farmer taking on the value of 1 if the farmer has an off-farm activity, and 0 if not. The fact for a farmer to practice a non agricultural activity enables him to have the means of purchasing manures more easily. Thus this variable is expected to act positively on the use of the RDW.

VEG is a dummy variable that indexes the kind of crop practiced taking on the value of 1 if the farmer produces vegetables and 0 if not (mainly flowers). The type of RDW used depends on the type of practised crop. For example floriculture may require more chemical inputs than vegetable crops.

CHEMEXP is a variable that measures the expenditures in chemical inputs. Considering the substitution effects between chemical products and organic waste, it is expected that the expenditure in chemical inputs influences the use of the RDW negatively.

DISTHOME is the distance between the house of the farmer and their farm. As hypothesized in Nkamleu (2000), the bulky and sanitarian character of waste means that to live far from his land is expected to influence negatively the decision to use RDW.

BREEDING is a dummy variable that indexes the fact that a farmer is involved in nursery activities, taking on the value of 1 if the farmer is involved in nursery activities and 0 if not. Horticulture nurseries are common in the Ekozoa swamp area. Since this activity is labor intensive, it is expected that the practise of breeding influences positively the decision of the farmer to use the RDW.

BUYRLW is a dummy variable that indexes the purchase of recycled livestock wastes used taking on the value of 1 if recycled livestock wastes was purchased and 0 if not: according to whether the livestock wastes used are bought or not, their origin influences their use in the farms.

SURFACE is a variable that measure the surface of the farm. The bulky character of waste does not always permit farmers to use the RDW on large surfaces. It is therefore expected that size acts negatively to the use of RDW.

ANIMW is a dummy variable that indexes the use of recycled livestock wastes taking on 1 if the farmer uses recycled livestock wastes and 0 if not. It is expected that the use of the recycled livestock wastes generally influence positively the use of fresh and decomposed kitchen waste.

ASSOC is a dummy variable that indexes the membership of the farmer to an association taking on 1 if the farmer belongs to an association and 0 if not. Since it is hypothesized that associations facilitate access to information, it is expected that to be member of an ASSOC influences positively a farmer to use the RDW.

The reduced form of our two models is written:

$$USERKW = \beta_0 + \beta_1 SEX + \beta_2 VEG + \beta_3 DISTHOME + \beta_4 SURFACE + \beta_5 DAAR + \beta_6 SIZE + \beta_7 NONAGR + \beta_8 CHEMEXP + \beta_9 BREEDING + \beta_{10} ASSOC$$

With USERKW = 1 if the farmer uses recovered and recycled fresh and decomposed kitchen waste, and 0 if not.

$$ANIW = \beta_0 + \beta_1 SEX + \beta_2 AGE + \beta_3 EDUC + \beta_4 NONAGR + \beta_5 VEG + \beta_6 CHEMEXP + \beta_7 DISTHOME + \beta_8 BREEDING + \beta_9 BUYRLW + \beta_{10} SURFACE$$

With ANIW = 1 if the farmer uses waste of recovered and recycled animals, and 0 if not.

5. Results

The results of the Logit model for the adoption of recycled fresh and decomposed kitchen waste in urban swamps of Cameroon are displayed in Table 1.

Table 1: Logit model results of adoption of recycled fresh and decomposed kitchen waste in urban swamps areas of Yaounde

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-5.46	5.01	-1.09	0.28
SEX				
- Woman	-9.48	6.20	-1.53	0.13
- Man	Ref.	Ref.	Ref.	Ref.
VEG				
- Vegetables	13.76	7.81	1.76	0.08***
- Flowers	Ref.	Ref.	Ref.	Ref.
DISTHOME				
- Not far < 500m	0.00	0.00	-1.69	0.09***
- Far >500m	Ref.	Ref.	Ref.	Ref.
SURFACE	0.00	0.00	0.32	0.75
USERLW				
- Use	12.63	7.43	1.70	0.09***
- Do not use	Ref.	Ref.	Ref.	Ref.
SIZE	-0.11	0.18	-0.63	0.53
NONAGR				
- Yes	2.52	2.40	1.05	0.29
- No	Ref.	Ref.	Ref.	Ref.
CHEMEXP	-0.01	0.01	-0.89	0.37
BREEDING				
- Yes	-0.71	1.38	-0.51	0.61
- No	Ref.	Ref.	Ref.	Ref.
ASSOC				
- Yes	-0.22	1.13	-0.19	0.85
- No	Ref.	Ref.	Ref.	Ref.

*****Significant at 1%, ******Significant at 5%, ******* Significant at 10%.
Ref.= Reference modality.

The model is statistically valid with a likelihood ratio (LR) equal to 22.75. The model is significant at the 5 per cent level with an R^2 equal to 0.42. The percentage of good prediction of the model is 90.57 per cent.

Three relevant variables explain the use of the recycled fresh and decomposed kitchen waste in the swamp areas of Yaounde: type of crop practiced (VEG), the distance between the house of the farmer and their farm (DISTHOME) and the use of the farmer of recycled livestock wastes (USERLW).

The production of vegetables positively influences the use of fresh and decomposed kitchen waste in these swamp areas. It should be noted that this activity is practised respectively by all (100 per cent), 93 per cent and 13 per cent of the farmers of Nkolondom, Etoug-Ebé and Ekozoa.

Distance between the house of the farmer and their farm (DISTHOME) is significant at 10 per cent. The negative sign of the coefficient of the modality means that, the farther the farmers live from their farm, the less likely they will use recycled fresh and decomposed kitchen waste. This finding complements other studies about the positive relationship between chemical use and distance (Nkamleu, 2000).

The use of recycled livestock wastes (USERLW) has a positive relationship to the use of recycled fresh and decomposed kitchen waste. The investigations showed that fresh and decomposed kitchen waste follows two different cycles in the swamp areas of Yaounde. Pig breeder farmers first store all their fresh and decomposed kitchen waste in their pigsties before carrying the mixture (fresh and decomposed kitchen waste and liquid manures) to their fields. On the other hand, farmers who are not livestock breeders, first put their fresh and decomposed kitchen waste behind their houses before carrying them after a few days to their lands. It is this complementarity, fresh and decomposed kitchen waste - livestock wastes which explains the significance of the modality "use of the recycled livestock wastes".

The results of the Logit model for the adoption of recycled animals waste in urban swamps of Cameroon are displayed in Table 2.

Table 2: Logit model results of use adoption of recycled animals waste in urban swamps areas of Yaounde

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	10.88	8.03	1.35	0.18
SEX				
- Woman	-1.68	1.97	-0.86	0.39
- Man	Ref.	Ref.	Ref.	Ref.
AGE	-0.29	0.14	-1.99	0.05**
EDUC				
-Neither	Ref.	Ref.	Ref.	Ref.
-Primary school	4.57	1.91	2.39	0.02**
-Secondary school	1.26	1.84	0.68	0.49
NONAGR				
- Yes	0.29	1.30	0.22	0.83
- No	Ref.	Ref.	Ref.	Ref.
VEG				
- Vegetables	Ref.	Ref.	Ref.	Ref.
- Flowers	2.30	3.99	0.58	0.56
CHEMEXP	-0.01	0.02	-0.73	0.47
DISTHOME				
- Not far < 500m	0.00	0.00	-1.65	0.10***
- Far > 500m	Ref.	Ref.	Ref.	Ref.
BREEDING				
- Yes	2.62	2.38	1.10	0.27
- No	Ref.	Ref.	Ref.	Ref.
BUYRLW				
- Yes	2.69	2.05	1.31	0.19
- No	Ref.	Ref.	Ref.	Ref.
SURFACE	0.01	0.00	1.73	0.08***

*****Significant at 1%, ******Significant at 5%, ******* Significant at 10%

Ref. = reference modality

The model is statistically valid with a likelihood ratio (LR) of 26.15. The model is significant at the 5 per cent level, with an R^2 equal 0.47. This is rather satisfactory as the percentage of good prediction of the model is 92 per cent.

The estimated model identifies four relevant variables explaining the use recycled animal waste (ANIW) in the swamp areas of Yaounde: the age of the farmer (AGE), the level of education (EDUC), the distance between the house of the farmer and their crop field (DISTHOME) and the surface of the field (SURFACE).

The age of the farmer (AGE) is negative and significant to 5 per cent. Indeed, as the theory confirms, the older the farmer, the less they use recycled animal waste (ANIW). The transport of the recycled animal waste (especially liquid pig manures) to the lands requires much physical force and thus reduces the probability for an old farmer to use them.

The level of education (EDUC) is positively significant at 5 per cent, which means that the probability of using the recycled animal waste is higher for a farmer having at least a primary school education than for a farmer who has never been to school.

The distance between the house of the farmer and their farm (DISTHOME), as in the estimate of the USERKW model, is negatively significant at 10 per cent. The farther the farmers live from their farm, the less likely they will use recycled animal waste.

The surface of the farm (SURFACE) is significantly linked to the use of recycled animal waste used. It should be noted however that the heavy weight of waste is not considered here. This is explained by the fact that the animal waste (hen droppings) used in the swamp areas of Yaounde are specifically purchased and weigh less than compost.

In the Logit models the dependent variable is a probability, the use of quasi - elasticities, which can be interpreted as the slopes of the logistic curve, which translates the factor of adoption. This makes it possible to appreciate the impact of the discrete explanatory variables on the probability of the use of domestic waste (Cramer, 1991). Quasi - elasticities are calculated starting from the formula:

$\eta = dP(x /dLog(x) = [p(\alpha+\beta x)p(1-p(\alpha+\beta x)]\beta x_i$

$\eta_{\beta i} = [p(1-p)]\ \beta_i$

p=0.88 is the value of the "Mean dependent variable" (table 5) which is the probability of using recycled animal waste.

Table 3: Quasi – elasticities of the probability

Variable	Estimated coefficient	Quasi – elasticity
Age of the farmer	-0.288	-0.030
Surface of the farm	0.006	0.001

The quasi – elasticity of the probability of using recycled animal waste compared to the two significant discrete variables “age of the farmer" and "surface of the farm" indicate that when the age of the farmer increases by one year, the probability of using recycled animals waste decreases by 3.04 per cent (elastic) whereas the increase of the surface of the farm (per m²) has no influence on the probability of using the recycled animal waste.

6. Conclusions

The purpose of this paper was to identify the variables likely to influence the use for recycling domestic waste in the swamp areas of Yaounde. To this end, we estimated two logistic models, one concerned with the adoption of recycled fresh and decomposed kitchen waste and the other concerned with the adoption of recycled animals waste, such as hen droppings and liquid pig manure.

Six variables are likely to influence the demand for domestic waste in the swamp areas of Yaounde: the type of crop produced, the use of recycled livestock wastes, the age of the

farmer, the level of education, the surface of the farm and the distance between the house of the farmer and their farm. The compost, which is the most important recycling mode for domestic waste, is not used in swamp areas of Yaounde because of its scarcity and high costs.

The distance between the house of the farmer and the farm appears as the key variable for an effective way to support the expansion of urban and peri-urban agriculture in the town of Yaounde. The two estimated models showed that the closer the farmers live to their farm, the more likely they will use recycled domestic wastes. This result is in accordance with the complementary conclusion of Nkamleu (2000) who argued that chemical fertilizers are more likely to be used on distant fields.

Recycled wastes are very rich in organic matter for fresh or decomposed kitchen waste; and in nitrogen and potassium for recycled animal waste. In this context, in order to promote the recovery of domestic waste and its recycling in swamp areas of Yaounde, domestic waste management should be revised through the construction of waste collection transfer stations in the swamp areas near the farms.

Waste collection transfer stations should be enclosed, and large enough (at least 1000 m2 in order to limit sanitary and health risks) to be used for the collection and for storage of waste produced by households living in swamp areas. These stations should also be adequately equipped for sorting and composting.

Domestic waste services require close attention and concern for socio-economic development, good governance, and sanitary issues. Our study shows that the construction of these waste collection transfer stations in swamp areas inaccessible to collecting trucks could alleviate significantly the sanitary issues of waste disposals and maintain sustainable productivity for urban and periurban agriculture.

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