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Willingness to pay of the households to a waste management improvement in the precarious districts of Abidjan (Ivory Coast)

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Abstract

This paper is among the first scientific approaches trying to explore the significant factors that influence households' willingness to financially take part into programs of domestic waste management improvement in Abidjan's precarious districts. Our methodology consists of directly asking households whether they are willing to financially contribute to the project or not. If so, how much they are willing to donate. Our first results from probit regression analysis indicate that households are well acquainted with the necessity to improve waste management; nonetheless they are less keen on bestowing money. Our study has revealed original results. It allows us to calculate the income elasticity of willingness to participate in the implementation of the project and shows that the coveted funding modality by households is the integration of a tax in the current fee.

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1. Introduction

Waste management and access to households' improved sanitation systems are huge challenges in developing countries. These challenges result from high population growth, industrialization and improved living standards. As such, the Ivorian people are exposed to environmental threats and to health related issues. The amelioration of these public services includes important investments from public policies. These services are only provided in privileged middle class and upper class dominated districts, in many developing countries' areas. Nevertheless necessary services are almost absent in areas dominated by the poor. As a point of fact, a 2013 survey on health showed that only 21,9% of Ivorians have access to improved sanitation facilities and that 44.7% of poor households have access to a public service for the waste collecting. Others either call upon informal sites or private individuals (25.2%) instead INS-ENV (2015).

This is a real issue for essential services like waste and sanitation. So every country includes solutions that aim at improving both populations' living standards and the environmental protection for generations to come as part of goal 7 of the Millennium Development Goals (MDGs). So it is important for authorities to identify all the costs and means to meet the latter subsequently.

In this paper we seek to identify the determinants of households' willingness to participate to waste management services and sanitation improved in precarious districts of Abidjan.

In fact the motivation of this paper is to identify factors influencing the decision of household's involvement in an improved project of waste management services and sanitation. Indeed, the survey comes as part of an emergency project of urban infrastructures set up by the Government of the Republic of the Ivory Coast and the World Bank. The project aims at to improving both the access to urban infrastructures (water, urban sanitation, solid waste, urban roads and local authorities) in major urban centers and the quality of the environment and public health by implementing measures of prevention and recycling. These objectives account for our choice of a scenario to households on the establishment of better collection services of households' waste. The interest of this paper is also to assess households' adherence or not to the program that is to provide a pickup system with two collection bins in the one hand and to measure the financial support granted by households who say they want adhere to the proposed program on the other.

To study this issue we use a Contingent Valuation Method (CVM) is the one most used in available literature data, in order to assess the advantages of non-marketed commodities and services. This method can in fact create hypothetic scenarios that can be used to provoke households willingness to pay to make specific modifications that are linked to an environmental good (Mitchell et *al.*, 1989; Bishop et *al.*, 1998; Carson et *al*., 2001, Carson *et al.,* 2003) and rarely willingness to accept for the compensation for the degradation of well-being (Hanemann 1999; Bateman *et al.,* 2002) quoted by Carson et *al.*, 2003.

As far as we know, no study has used CVM in the field of solid waste management and sanitation in Ivory Coast. Determining the contribution of households to improve the identified essentials services is therefore reasonable. In particular we identify the characteristics that affect the household's decision making for quality services.

Our methodology consists of directly asking households whether they are willing to financially contribute to the project or not. If so, how much they are ready to donate.

Our first results from probit regression analysis indicate that households are well acquainted with the necessity to better improve waste management; nonetheless they are less keen on bestowing money. Beyond testing the known determinants of literature, our study concludes with specific determinants related to the problem and characteristics of the area and leads to policy recommendations. Indeed our study allows to calculate the elasticity of the WTP for

the implementation of the project in respect of income and reveals the financing modality coveted by households is the integration of a tax in the current fee.
In the following sections, we will fist present the determining factors that compel households into eagerly funding the management of their waste, according to our bibliographic sources, we present the methodology of our probe and then we proceed with our econometric analysis before the results and a conclusion and policy implication.

2. Factors influencing households to financially contribute to waste management

The literature in domestic waste management is relatively abundant. Generally authors address this issue by the determinants of households' willingness to pay for improving the management service, or their willingness to participation in waste recycling (Afroz *et al*., 2009; Mir *et al.,* 1996, Dadson *et al.,* 2013; Banga *et al.,* 2011; Yusuf *et al.* 2007; Jin *et al.*, 2006).
We suggest summarized in Table 1 below the results of the closest studies of our issue that we will comment.

Table 1. Factors influencing willingness to pay

Determinants of household's willingness to pay	**Significant**	**Not significant**
Demographic		
Age	Amfo-Otu *et al*. (2012), Afroz *et al*. (2009)	Dadson *et al.* (2013)
Gender	Dadson *et al.* (2013)	Afroz *et al.* (2009), Banga *et al.* (2011)
Education	Afroz *et al.* (2009), Dadson *et al.* (2013), Banga *et al.* (2011), Jin *et al*. (2006)	
Household size	Yusuf *et al.* (2007), Mustafa *et al.* (2014)	Banga *et al.* (2011)
Economic		
Income	Afroz *et al*. (2009), Jin *et al.*, 2006, Banga *et al.* (2011)	
Individual preferences and awareness		
Satisfaction by the waste management service	Afroz *et al*. (2009)	
The household agree to separate his waste	Afroz *et al.* (2009)	
The household is aware that wastes are a threat of environment	Afroz *et al*. (2009), Mustafa *et al.* (2014)	

Source: Author (2016)

In these papers, the different results show that households are generally favorable to the improvement of the management systems but their financial contribution depends on their life characteristics. For example, in their works, Afroz *et al.* (2009) show that the regulators can choose from a set of scenarios that include different levels of attributes and the associated willingness to pay to set a model that improves the garbage collection system. According to these authors, the authorities must be aware that the socio-economic characteristics of households and the quality of collection services still influence the willingness to pay. In a paper about the determinants of willingness to pay for improving waste management in Oyo State in Nigeria, Yusuf *et al.* (2007) show that the price of the service provided and the monthly household expenditure determine their willingness to pay. They argue that households should require their participation in the improvement of waste management for their welfare.

Banga *et al.* (2011) use double-bounded contingent valuation method to show that households' mean willingness to pay for improved solid waste collection service was estimated to be USD 2,439 per month. They also indicate that both the decision to pay and that the amount households are willing to pay for improved solid waste collection services are influenced by income, education, age and home ownership.

The results from a double-bounded dichotomous choice contingent valuation method and choice experiment study conducted by Jin *et al.* (2006) in order to examine Macao (in China) residents' preferences for alternative solid waste management policy changes show that there is no significant difference from these two methods. But the benefits of the CVM approach is that it can directly estimate the economic values for a specific situation and statistical estimation is relatively easy.

In order to examine household's willingness to pay for improved solid waste management services Kumasi Metropolitan Assembly area in Ghana, Dadson *et al.* (2013) use a logit model and show that income, age, number of children, quantity of waste generated, and education have significant effect on household's decision. Using a Tobit model the authors also show that the amount announced by households is influenced by their income, quantity of waste generated, education, house ownership, and number children. In a similar study (improving waste management and sanitation systems) conducted in Pakistan by Mustafa *et al.* (2014), the variables related to the size and awareness of the household are also determinants of household's willingness to pay.

This literature review has guided us in our designed questionnaire. We will see if we get similar determinants and if other factors also influence households' adhesion to that specific program in our field of study that includes the precarious districts of Abidjan. In other words, do we find the standard determinants or are there specific determinants?

3. Methodology

3.1. Survey area and sampling method

- *Empirical design and data collection*

We have conducted this survey with the help of student trainees from the National Institute of Statistics of Ivory Coast.

The data used in this article come from a household survey undertaken between May and July 2014 in twenty precarious districts of Abidjan. This sample covered a total of 402 respondents for analyzing households' enthusiasm to financially partake in the improvement of waste management. The sample was based on the administrative division of the last census (INS, 2013).

Abidjan's blueprint (1996) defines eight kinds of habitat which could be divided into four big groups; spontaneous habitats, evolving and economic ones, and residential habitats. Our study

mainly focuses on the first group of spontaneous or precarious habitat. The latter can be defined as an ensemble of houses with no lease (Terrabo, 2010). According to Deler *et al.* (1998), the establishment of essential services in such districts barely exists. This derives from judicial reasons that highly influence the realization of such services to a judicial real estate status and to the respect of urbanization rules.
The data are randomly sampled. Indeed, on the basis of 183 precarious districts identified by statistic institute, we randomly selected to investigate in 20 areas. The precarious districts have 577136 households and we investigated 402 households on this total.
Upon the collecting of our data, we proceeded to face to face interviews that lasted between 20 and 30 minutes.

- *Questionnaire designed*

Our questionnaire is divided into six sections: the first one has a string of questions related to interviewees' identification. As for the second section, it identifies the details about the social economic characteristics of households. The third section explores domestic waste management in the poor districts of Abidjan. This section starts from the families' habits as related with their own waste on the one hand, and in relation with their general knowledge on consequences linked to waste on the other. Then in our first subheading we present a hypothetic scenario for the amelioration of domestic waste management apparatus in order to have households' willingness for the funding of a new service. This scenario is inspired by the infrastructure's emergency project that has been initiated by the government and the World Bank. It aims at improving access to urban infrastructures (drinking water, urban sanitation, solid waste, urban roads and local authorities) in Abidjan, Bouake and other cities throughout Ivory Coast. Thus this information will be given to households and the secretary of state for the environment's intentions to ameliorate their living standards and their health will be given at the same time. And after, they will be told it will be about:
"The provision of two collection bins (improved) with a twice-weekly frequency of collection. The launching of this program's cost will be covered but its managing fees will be funded by households, merchants and waste generating companies. The total amount of people's financial participation will cover the fees for the emptying and sustaining of the 120 liters garbage bins that have been put at their disposal on the one hand. One the other hand it will help build a better refuse collection frequency (2 times per week)"
This paper is essentially based on the first part concerning the households' willingness to participate.
In subsequent questions about the CVM, we would rather ask families that had opted out for the present situation questions related to their WTP. To Families that had accepted to take part in the improvement project, we have asked to reveal their WTP for such an amelioration. Then we asked them to choose a means of payment among the list we had presented them[1].
The last two sections are related to wastewater management features and access to drinking water. Eventually we obtained 402 complete answers which our estimations are based on.

3.2 Variables and descriptive statistics

The aim is to analyze household's willingness to participate in a program of improvement of waste collection services in one way and to pay for the management of the service. In this paper we tackle the first question as related to the willingness to participate in the improvement of waste management services.

[1] As payment vehicle, we offer a direct payment to the public authority or an individual or a supplement to the water bill or electricity.

Our choice of relevant variable parameters in our study has been oriented following the basis of the technical journal as shown in Table 1. Nevertheless the expected effects for the different variables refer to the particular case of our domain of study.
So, the dataset include socio-economic characteristics of households, their current mode of waste management and sanitation, and also their hygienic and health practices.
About gender, we expect that women are more willing to pay than men, as is traditionally the role of women for house cleaning and waste disposal (UNDP, 2015). But in these areas women consider that they are too busy with small shops for households' needs, therefore are not so willing to financially participate in a new program.
The dataset also provide localization variables: Towns variables (5), precarious district variables (20) and Sub-District variables[2].
The Republic of Ivory Coast is divided into, Districts and Sub-Districts. The mode of waste management depends on the type of habitat. What's more, Abidjan is divided into four managing areas. Every zone is composed of a certain number of municipalities affiliated with waste collecting companies each. But reality has taught us there are anarchic refuse collections in the streets. A pre collection activity has subsequently developed in Abidjan's communes. This method is used by households as an alternative in case of want of official service. The costs of pay monthly services vary according to the municipalities' living standards. Case in point, the Cocody commune is composed of much upscale housing. Abobo has very few domestic waste management infrastructures. As for Yopougon, it is the one with most precarious districts. In addition there are two other municipalities (Adjame and Attecoube)[3] in our database.
Regarding utilities, we have information on the percentage of households that are satisfied by the waste management service, households accept to pay for the amount of waste produced and they are aware that wastes are a threat for health. We use dummy variables indicating whether households say yes or no. The type of latrines (flush systems or simple) in the MDGs' sense and the type of emptying used by the household are included. As OMS (2014) shows that inadequate management of households' waste and improper use of sanitation facilities is an important risk of an outbreak of various diseases related to the environment. Therefore we can expect that a better understanding of the consequences of the management of these services positively influences the decision of households (Mustafa *et al.*, 2014).
The survey also included questions on household income. There is a general agreement in the environmental economics literature on the positive relationship between income and demand for improvement in environmental quality (Afroz, 2011). Therefore, we expect the income to affect the willingness to pay and its amount positively.
Finally, the quality of the current household waste management could be a determinant of the households' willingness to participate (Afroz *et al*., 2009). The quality of this kind of service is measured by the opinion of households. Hence to avoid the problem of the endogeneity of this variable, Briand *et al.,* (2009) propose to link every household *i* in an area *j* to the average opinion of its district, this average opinion being calculated by using the opinion of all households of the area *j* except the household *i*. The opinion variable that we use is the part of households which consider that the quality of waste management services is satisfying or not.

[2] We take into account the variable on municipalities as for district; we would have twenty binary variables.
[3] Adjame and Attecoube municipalities have little precarious district and have no impact on our results.

Table 2. Descriptive statistics

Variables	Signification	Sample mean	Std. Dev.	Min	Max
Participation	1 if the household willingness to participate financially	0.913	0.282	0	1
HH_Female	1 if the head of the household is a woman	0.167	0.373	0	1
HH_Schooled	1 if the head of the household is not schooled	0.204	0.403	0	1
P_Social programs	1 if the household participates to other social programs	0.784	0.412	0	1
H_Owns	1 if the household owns its house	0.179	0.384	0	1
Rooms	The number of rooms in the dwelling	1.818	1.261	1	9
Health	1 if the household is aware that wastes are a threat for health	0.965	0.184	0	1
M_Emptying	1 if the household uses manual emptying	0.823	0.382	0	1
Latrine_Flush	1 if the household uses latrines with flush system	0.828	0.378	0	1
Latrine_Simple	1 if the household uses simple household's latrine	0.507	0.501	0	1
Redev	1 if the household accepts to pay for the amount of waste produced	0.318	0.466	0	1
Satisfied	The percentage of household who are satisfied by the waste management service	0.380	0.169	-	-
Abobo	The household is in the municipality of Abobo	0.047	0.212	0	1
Cocody	The household is in the municipality of Cocody	0.199	0.400	0	1
Yopougon	The household is in the municipality of Yopougon	0.654	0.476	0	1
Wealth index	The wealth index of household	-0.400	3.438	-7.539	15.576

Source: Author (2016)

Our survey shows that 91% accept to participate financially to the new project. 65% of the households are in the area of Yopougon, 20% in Cocody and only 5% in Abobo municipality. Descriptive statistics also indicate that about 82% of households empty their latrines manually and 82% of the sample use flush latrines.

The survey also shows that 96% of households are aware that wastes are a threat for health and 78% take part into social programs[4].

Table 3. Distribution of Household Income

Income		**Number of respondents**	**precentage**
Income0_150	The household income is between [0 - 150 000][5]	191	47,51
Income151_200	The household income is between [151 000 - 200 000]	70	17,41
Income201_500	The household income is between [201 000 - 500 000]	88	21,89
Income_500+	The household income is more than 500	3	0,75
Don't want to answer	The household refuses to declare his income.	50	12,44
Total		402	100

Source: Author (2016)

3.4 Model

This study examines the factors that influence household's willingness to participate financially to the improvement of the service to be provided to them using binary choice modeling (probit model). We use the Maximum Likelihood method to estimate the parameters in logistic regression model. The dependent variable is designed as a dichotomous dummy because of assuming whether the respondent is willing to participate financially or not.
The model is as,

$$Log\ \frac{P_i}{(1-P_i)} = \beta_0 + \beta_i X_i + \varepsilon$$

Where,
P_i = 1 if the respondent is willing to participate for improved waste management;
P_i = 0 for otherwise;
X_i = independent variables;
β_0 = constant term;
β_i = coefficient of independent variables;
ε = the error or disturbance term;
i = 1,2,3, . . .,n.

The dependent variables of the model are presented in Table 2.

[4] Descriptive statistics on the amount paid by households to individuals for the collection of their waste, the methods of pre-collection used by households and Knowledge about solid waste consequences and kind of consequence are presented in Appendix A1, A2 and A3.
[5] In FCFA knowing that USD 1 = FCFA 583.5

3.5. Empirical analysis

Many studies have used the contingent valuation method to promote non market goods. (see Table 1). Yet it has been demonstrated by many authors (Mitchell *et al.,* 1989; Blamey *et al.,* 1999; Kahneman *et al.,* 1992) that such a method has some flaws which should be taken into account so as to ensure the validity of results. Thus the NOAA (Arrow *et al.*, 1993) recommends each contingent valuation study (should) have an integrated mechanism called internal consistency test to assess the results' validity. So households that have been surveyed have correctly been informed as far as the specific environmental damages are concerned (improvement of the households' living standard and health). They have likely been about the scope of substitutes, available alternatives (two garbage bins of different colors per household in order to clearly separate refuse). Families have also been obviously presented methods of payment (an independent bill which is either managed by individuals or by state officials; otherwise an extra water or electricity bill will do). We have asked them to start giving the current amount that they pay for the elimination of their waste, in order to avoid any temptation of exaggerating the costs.

Due to the high number of available characteristics, multicollinearity is potentially a serious concern. Recall that multicollinearity leads to unstable coefficients and inflated standard errors. First, the correlation analysis is used between variables in pairs in order to delete one of them when the correlation is superior or equal to 0.50. Secondly, we use Variance Inflation Factors (VIFs) to detect the unstable coefficients and inflated standard errors characteristic of multicollinearity. VIF values do not exceed 2.97 (and mean VIFs do not exceed 1.5) in the model

4. Results

For a better robustness of our prototype, we have estimated three probit models out of a sample of 402 households (Table 4). We have created a variety of variables in relation with material wealth (wealth index) and that are linked to monetary income. The first model is estimated with wealth index only. As for the second one, it is estimated with net cash income and the third model includes both wealth variables.
We chose to realize the variants on material wealth for income estimation is a real hurdle against surveys conducted in Africa, generally speaking. Answers are very unreliable and some families even refuse to give answers sometimes.
Globally model 3 has good predictive validity. It predicts that 367 households accept to participate financially to the new project of waste management. It predicts also that 34 households do not wish to participate financially to the new project. Hence, the prediction rate is 92.27%[6].

In order to study the factors which influence the willingness to participate financially for the improvement of the service, we estimate the marginal effects after a probit model. Our results are described below according to the identified groups of variables.

[6] In addition, Mac Fadden's R2 is equal to 36.40% (see Appendix A4) which represents a value superior to the threshold that's been assessed as the minimal requirement to justify the robustness of any probit model (25%).

- *Household characteristics variables*

The positive influence of the variable *the household owns its dwelling* supposes that this kind of household is more motivated to invest in programs to improve the quality of the environment of their district.

The variable *the number of rooms in the dwelling* shows that the more rooms there are in the dwelling, the less motivated are households by the new project of waste management services. If household size can be measured by considering the number of rooms in the dwelling, in this case, our results are in the expected direction. Indeed, the higher the size of the household is, the less households are motivated to participate financially due to budget constraints. Pek and Jamal (2011) show that the greater the number of persons in the household is, the higher is their motivation to participate financially. In fact, in this case households produce more and more waste and are face difficulties to eliminate them. Hence the household is motivated to participate financially to a project which improves the waste management services. In contrast, this variable can be considered as a wealth indicator. In this case, the greater the number of rooms in the dwelling is, the less the motivation to participate is (Filmer *et al.*, 2001).

The negative effect for the municipality of Cocody can be explained by the fact that it is the richest municipality of Abidjan. The precarious districts of our study are near the municipality of Cocody. So, they have trash bins like the neighbors of the richest districts of the municipality. This means those surveyed who do not walk long distances to remove their waste are not willing to participate in the waste management's improvement.

Early studies show that distance has a positive impact on the willingness to pay (Nkansah *et al.*, 2015; Dadson *et al.*, 2013). However according to Tadesse *et al.*, (2009), when the distance of municipalities' containers increases, households' willingness to pay for these services declines because the closer the waste containers are to their places, the more willing are households to pay for it.

- *Economic variable*

When *the household income is between [151,000-200,000]*, the probability for the household to participate financially is higher. This result is in the expected direction. It is relevant because the poverty threshold in Ivory Coast which equals USD 317.703 is in this interval of income. So, the households are able to participate to the project.

This result seems reasonable since a higher level of income could be related to a greater ability to pay. The positive relationship between this variable is generally supported by the WTP literature. For example, income had a positive effect on WTP in several studies (Afroz *et al.*, 2011, Jin *et al.*, 2006; Basli *et al.*, 2006; Caplan *et al.*, 2002).

- *Environmental characteristics variables*

The variables: *the household uses manual emptying* has sign which is in the expected direction. Indeed, the literature shows that the households which are aware that wastes are a threat for the health are motivated to participate to a program for the improvement of the waste management services. Moreover, the use of manual emptying is not hygienic. It could lead to negative effects on their environment and hence their health. The positive sign of waste management consequences is supported by the results of the study conducted by (Cairncross *et al.*, 2010).

The households which use simple latrines are more motivated to financially partake in the improvement of the waste management services than those which use flush latrines. Although these two kinds of latrines correspond to improved sanitation facilities as defined by the Millennium Development Goals, the households which use simple latrines could consider that they are less hygienic and hence, are more motivated to participate to the project.

Table 4. Probabilities of the willingness to participate financially to the improved wastes services using probit model.

VARIABLES	Model 1		Model 2		Model 3	
	Coef.	Marg. Eff.	Coef.	Marg. Eff.	Coef.	Marg. Eff.
Household characteristics						
CM_Femme	0.118	0.003	0.122	0.006	0.102	0.002
	(0.385)	(0.009)	(0.350)	(0.016)	(0.386)	(0.008)
CM_NoScol	-0.395	-0.014	-0.301	-0.019	-0.439	-0.015
	(0.277)	(0.014)	(0.259)	(0.020)	(0.282)	(0.014)
Par_Aut_Prg	0.756**	0.036	0.632**	0.048	0.781**	0.036
	(0.303)	(0.026)	(0.270)	(0.032)	(0.306)	(0.026)
Proprio	1.976***	0.025*	1.306***	0.036**	2.039***	0.024*
	(0.607)	(0.013)	(0.473)	(0.016)	(0.616)	(0.013)
NbrePiece_Log	-0.517***	-0.014*	-0.289**	-0.015**	-0.489***	-0.012*
	(0.140)	(0.007)	(0.126)	(0.007)	(0.147)	(0.007)
municipalities						
Abobo	-1.376*	-0.148	-0.972	-0.118	-1.321*	-0.130
	(0.711)	(0.164)	(0.625)	(0.135)	(0.715)	(0.153)
Cocody	-1.590**	-0.144	-0.948*	-0.090	-1.529**	-0.127
	(0.658)	(0.118)	(0.565)	(0.085)	(0.663)	(0.110)
Yopougon	-1.068*	-0.024	-0.625	-0.028	-1.003	-0.021
	(0.612)	(0.018)	(0.522)	(0.023)	(0.615)	(0.017)
Economic						
Revenu0_150	0.351	0.010			0.476	0.012
	(1.154)	(0.032)			(1.215)	(0.032)
Revenu151_200	1.313***	0.103**			1.262***	0.091**
	(0.290)	(0.046)			(0.293)	(0.044)
Revenu201_500	-0.164	-0.004			-0.443	-0.011
	(0.581)	(0.016)			(0.664)	(0.018)
Score_total			-0.066	-0.003	-0.067	-0.002
			(0.041)	(0.002)	(0.051)	(0.002)
Environmental characteristics						
Vid_Man	0.636**	0.029	0.607**	0.048	0.650**	0.028
	(0.295)	(0.023)	(0.275)	(0.032)	(0.297)	(0.023)
Latr_ChEau	-0.963	-0.015	-1.135*	-0.033**	-1.135*	-0.015
	(0.611)	(0.010)	(0.640)	(0.015)	(0.642)	(0.010)
Latr_Simp	0.681**	0.020	0.558*	0.030	0.754**	0.021
	(0.332)	(0.015)	(0.298)	(0.020)	(0.346)	(0.015)
Individual preferences and awareness						
DchMen_Sant	0.936*	0.069	0.569	0.050	0.971*	0.071
	(0.553)	(0.080)	(0.509)	(0.069)	(0.556)	(0.081)
Accep_Redev	1.451***	0.031**	1.402***	0.056***	1.532***	0.031**
	(0.539)	(0.015)	(0.502)	(0.019)	(0.556)	(0.015)
PartSatis_Dechet1	0.367	0.010	0.376	0.020	0.433	0.011
	(0.846)	(0.023)	(0.822)	(0.043)	(0.858)	(0.022)
Constant	-0.124		1.490		0.131	
	(4.948)		(1.112)		(5.206)	
Pseudo R2	0.357		0.268		0.364	
Observations	401	401	401	401	401	401

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author (2016)

- *Individual preferences and awareness*

When *the household accepts to pay for the amount of waste produced*, it increases the probability to participate financially to the waste management improvement.
The model also shows different results depending on the municipality where the household is.

- *What about the marginal effects?*

The analysis of marginal effect shows us two original results. Indeed household income positively influences the decision to participate in the enhanced program. This result relates to the income elasticity of willingness to participate. It shows that households whose income is between [151.000 to 200.000] would be willing to devote 9.1% of their income to participate in the improvement of waste management services. As the positive impact of participatory fee shows that the households' contribution goes through the integration of a tax to the current fee.

5. Conclusion and Policy implication

In this paper, our objective was to determine the willingness of households to participate financially to a program to improve the waste management services in the precarious districts of Abidjan. We conducted a survey in 2014 with a sample of 402 households belonging to precarious districts of Abidjan. Using a factor analysis applied to the survey data, we have elaborated a wealth index according to Filemr and Pritchett (2001) in order to analyze the heterogeneity of households in terms of income. The analysis of determinants of the willingness to financially participate for the waste management improvement by using probit model provides us original results. Particularly, we show that households which use low improved sanitation have a higher motivation to participate financially. Households are ready to participate to the project if their income is at least equal to the poverty line.
Our study reveals original results. It allows us to calculate the elasticity of WTP relative to income for the implementation of the project and shows that the coveted funding modality by households is the integration of a tax in the current fee.
Our study also provides a particular effect due to the profile of the area. As a point of fact most of districts are located by a natural channel with a steep working like a sewerage system. It is forbidden to construct in these areas and hence are not in the development program of the municipality. The absence of health infrastructures affects negatively the population in these areas.

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Appendix

A1: Amount paid by households to individuals for the collection of their waste

Montant	**Number of respondents**	**percentage**
Less than 500	9	7,63
500 - 999	62	52,54
1000 - 1500	38	32,2
More than 1500	9	7,63
Total	118	100

Source: Author (2016)

A2: The methods of pre-collection used by households

Methods of pre-collection	**Number of respondents**	**percentage**
Public bench	136	33,83
Private individuals	125	31,09
In nature	67	16,67
Burning	1	0,25
Grouping station	25	6,22
Channel / gutter	124	30,85
Neighbors	4	1
In the street	3	0,75

Source: Author (2016)

A3: Knowledge about solid waste consequences and kind of consequence

	Number of respondents	**percentage**
Answer		
Yes	370	92,04
No	32	7,96
Total	**402**	**100**
Problems		
Microbe	3	0,75
Disease	360	89,55
Environmental pollution	76	18,91
Insect / Mosquito	11	2,74
Piping	1	0,25
Do not know	4	1

Source: Author (2016)

A4: Model 3 test of robustness[7]

McFadden's R2:	0.364
Prob > chi2	0.0000
AIC	0.464
BIC	-2141.619

Source: Author (2016)

[7] The test results of models 1 and 2 are from the author on request.