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Sustainable Development

Willingness to Pay for Urban Solid Waste integral system in Semi-Urban Populations

Disposición a Pagar por un sistema integral de Residuos Sólidos Urbanos en poblaciones semi-urbanas

Francisco Iván Hernández Cuevas*[1], Diana Estefania Castillo Loeza[2], Javier Becerril García[3], and María Pía Mc Manus Gómez[4]

[1]*Escuela de Administración, Turismo y Mercadotecnia de la Universidad Marista de Mérida, México.*
[2]*Escuela de Administración de Recursos Naturales de la Universidad Marista de Mérida, México.*
[3]*Facultad de Economía de la Universidad Autónoma de Yucatán, México.*
[4]*Escuela de Administración de Recursos Naturales de la Universidad Marista de Mérida, México.*

*Corresponding author: fhernandez@marista.edu.mx

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Abstract

In Yucatan, the transition from rural to semi-urban communities has occurred mainly in the municipality seats; this transition comes with the problems of waste management. The municipalities oversee the Integral Urban Solid Waste Management (IUSWM); but in recent years, the public-private partnership for waste management has proved to be an effective strategy. There are few studies on the IUSWM in rural or semi-urban areas and the users' willingness to pay, information that would help public policymakers to design adequate plans and programs for its management. Therefore, the purpose of this study is to determine the socioeconomic factors associated with the willingness to pay for the IUSWM of users in semi-urban municipalities of Yucatan. A total of 1,144 interviews were conducted in 6 semi-urban localities in Yucatan, and the data were analyzed using descriptive and inferential statistics with a Tobit regression econometric model. 69.75% of the surveyed users declared that they were willing to pay an average of 17.65 Mexican pesos (0.85 U.S. dollars) for the integral urban solid waste management. The willingness to pay decreases when the Mayan language predominates among the member of the household, and when they have fewer tangible assets and rooms. There are cultural and social factors rooted in solid waste collection, this integrated system may be accompanied by other types of economic incentives to modify consumers' behavior towards something more beneficial for the environment, such as the homes' income.

Keywords: Urban Solid Waste (USW), Semi-rural area, Willingness to Pay (WTP), Tobit model.

Resumen

La transición de lo rural a lo semiurbano en Yucatán ocurre principalmente en las cabeceras municipales, y trae consigo problemas de gestión de los residuos. Las autoridades municipales son las encargadas del Manejo Integral de los Residuos Sólidos Urbanos (MIRSU); pero en últimos años, la asociación entre el sector público y el privado para la gestión de los residuos resulta una estrategia eficaz. Existen pocos estudios sobre el MIRSU en zonas rurales o semiurbanas y la disposición a pagar de los usuarios, información que ayudaría a los creadores de política pública a diseñar planes y programas adecuados para su gestión. Por lo tanto, el objetivo de este estudio es determinar los factores socioeconómicos asociados a la disposición a pagar por el MIRSU de los usuarios de municipios semiurbanos de Yucatán. Se realizaron 1,144 encuestas en 6 localidades semiurbanas de Yucatán, los datos se analizaron mediante estadística descriptiva e inferencial con un modelo econométrico de regresión Tobit. El 69,75% de los usuarios encuestados declararon estar dispuestos a pagar por el manejo integral de los residuos sólidos un monto promedio de 17,65 pesos mexicanos (0,85 dólares estadounidenses). La disposición a pagar disminuye cuando predomina el idioma maya, y mientras menos activos físicos y habitaciones tenga el hogar. Existen elementos culturales y sociales arraigados en la recolección de residuos sólidos, este sistema integral puede ir acompañado de otro tipo de incentivos económicos para modificar el comportamiento de los consumidores hacia algo más beneficioso para el medio ambiente, tal como el ingreso familiar.

Palabras clave: Residuos Sólidos Urbanos (RSU), áreas semi rurales, Disposición a Pagar (DAP), Modelo Tobit.

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Orcid IDs:

Francisco Iván Hernández Cuevas: https://orcid.org/0000-0002-1310-7574
Diana Estefania Castillo Loeza: https://orcid.org/0000-0002-0363-5883
Javier Becerril García: https://orcid.org/0000-0003-3785-1469
María Pía Mc Manus Gómez: https://orcid.org/0000-0002-3031-3652

1 Introduction

Globally, the problem of Urban Solid Waste (USW) is increasing due to the growth of population and the change in consumption patterns. According to Kaza et al. (2018), 242 million tons of plastic waste are generated worldwide, and 1.6 billion tons of carbon dioxide equivalent (CO_2 equivalent) greenhouse gas emissions were produced from solid waste management in 2016. If there is no improvement in solid waste generation, emissions will increase 62.5% by 2050.

In 2017, Mexico produced 102,895.00 tons of waste daily, from that amount 83.93% were collected, and 78.54% were disposed in final disposal sites, recycling only 9.63% (Secretaría de Medio Ambiente y Recursos Naturales, 2017). Official information (Fig. 1) at a country, state, and local level regarding solid waste generation is scarce and out of date (last official data was registered in 2012). Notwithstanding the preceding, explicit behavior is observed in the country's commitment to economic growth. The increase in average spending on private consumption by families has led to a constant increment in waste and waste generation. Even in times of economic crisis (2009), the generation of urban solid waste continued to escalate, this effect can be attributed to the economic pause generated by the mitigation actions of the COVID-19 pandemic and that now with the economic reopening, could have a more significant effect in terms of pollution.

The USW production is linked to human activities at the household level (Diario Oficial de la Federación, 2003), so its increase is also related to household consumption patterns and population growth. Research can reveal changes in consumption patterns; for instance, a study was conducted on the island of Crete to identify the composition of waste; the results indicated a change in consumption patterns, mainly due to the increase in packaging materials in contrast to the decrease in organic waste (Gidarakos et al., 2006). On the other hand, as the population grows in a region, it is necessary to establish a more organized form of waste management to maintain general health issues (Seadon, 2006).

The proper management in USW levels has not been accomplished yet (Marín García and Quintanilla Jerezano, 2007). Some USW disposed of landfills have a residual value, such as paper, PET, paper board, milk carton, metal, among others. However, when they are not reused or reintegrated into the economy, this value is missed (Taboada-González et al., 2013). The mismanagement of USW can create harmful effects such as soil, air, and water pollution, loss of biodiversity and health risks (Huamaní Montesinos, 2017; Srivastava et al., 2015). The proper management of USW is an issue that impacts the different dimensions of sustainability (da Silva et al., 2019); therefore, it is important that after collecting data about USW in studies, findings are used by the policymakers to develop or improve an adequate Integral Urban Solid Waste Management (IUSWM).

In Mexico, the *General Law for the Prevention and Comprehensive Management of Waste* of 2003 indicates that an IUSWM is a system related to actions to reduce, re-use, and re-cycle the waste produced, as well as their collection, storing, and final disposal, following the objectives of sanitation, restoration, and conservation of the environment. However, the sectors in which solid waste is generated include industrial, governmental, institutional, and health care (Srivastava et al., 2015).

There is not an accurate definition of IUSWM since it changes depending on the country; moreover, IUSWM goes further the final disposal. Tchobanoglous and Kreith (2002) suggest that selecting and applying appropriate management practices, technologies, and programs to accomplish the objectives can be called a system. The advantages of having an IUSWM in a country goes beyond the preservation of the population's health. It also involves the decrease in use of natural resources and pollution from untreated waste discharge; and indirectly, energy savings (Hui et al., 2006).

Nowadays, the problem of solid waste management is also present in urban and semi-urban areas because of the increase of urbanization. For instance, in the rural areas of India, waste is dumped in inappropriate places (roadsides, vacant lands, etc.), which is dangerous to the residents' health from these areas and affects the environment; there is no separation of waste, and although organic waste is fed to animals, changes in consumption patterns have increased the use of plastic materials that are

disposed in landfills (Vij, 2012). In rural areas of Egypt, it has been documented that solid waste is often dumped in drains and canals, open dumps or burned (El-Messery et al., 2009).

In the last decades in Mexico, rural areas have also been transformed from rural to urban and semi-urban due a demographic growth. This transition from rural to urban comes with the USW management problems, as well as the change in consumption habits. The State of Yucatan[1] is not exempt, it has experienced this transformation especially in municipality seats[2], some of which have reached the size of semi-urban areas. Unfortunately, the USW problem is present inside them (like the increasing use of disposable and dangerous materials). It is exacerbated when the communities have no adequate trash collection services. This remains latent in the information reported by Secretaría de Desarrollo Social (2013) (Table 1), where growth in the generation of urban solid waste can be observed in rural or semi-urban areas. The state of Yucatán has also registered increases in the volume of USW generation, obtaining a total of 620 thousand tons for the year 2012.

The only municipality in the state of Yucatan that has a sanitary landfill is Merida, and the other municipalities have lack of proper landfill. As a result, the waste in rural and semi-rural locations is burnt, and dumped in landfills, ground holes, and streets. Among the problems caused by poor management of USW there can be found environmental pollution (air, soil, water, visual), unpleasant odors, rodents and pests, and issues that endanger inhabitants' health (Canul Bacab and May Hoil, 2016). In Yucatán, initiatives have been developed due to USW, an example of these initiatives is that all its municipalities, have a Solid Waste Management Plan (Secretaría de Desarrollo Sustentable, 2021). However, the application of these plans requires investment, innovation, and the link between the social, private, and public sectors to begin having positive effects in reducing USW.

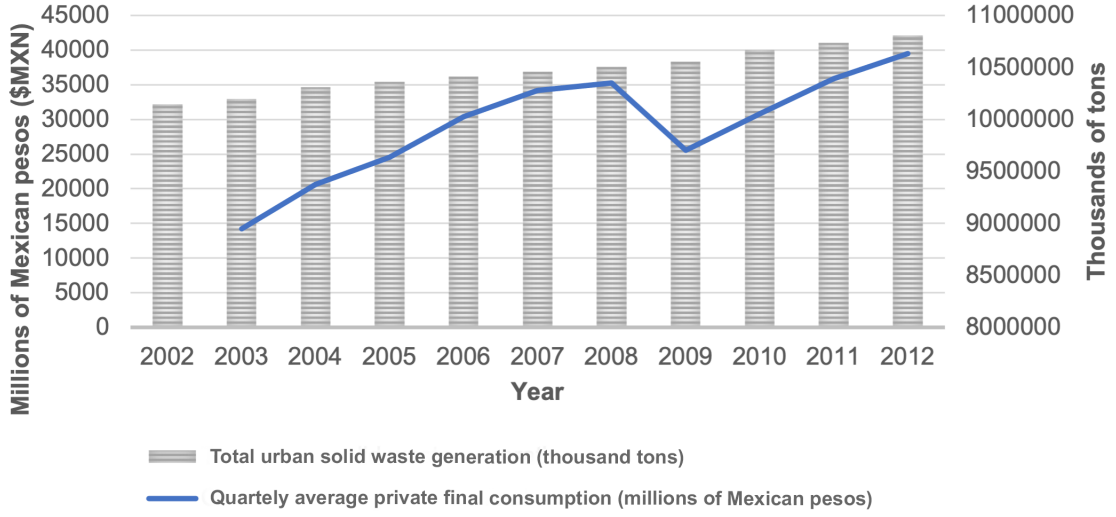

Figure 1. Urban solid waste generation and private consumption in Mexico
Source: Own elaboration based on data from Secretaría de Desarrollo Social (2013).

[1]One of the 32 states of the Mexican Republic.
[2]Also known as *Cabecera municipal* in Spanish. It is a city or town seat of the municipal government. Mexico has three levels of government: Federal, State and Municipal, and 32 States and 2 471 Municipalities.

Table 1. Urban solid waste generation by type area

Year	National urban solid waste generation (thousands of tons)	Urban solid waste generation in Yucatán (thousands of tons)	Solid waste generation in rural or semi-urban locations (thousands of tons)
2002	32 173.60	459.52	4 774.20
2003	32 915.70	470.85	4 793.00
2004	34 604.00	496.00	4 964.00
2005	35 405.00	509.00	5 326.00
2006	36 135.00	522.00	5 088.00
2007	36 865.00	551.00	5 021.00
2008	37 595.00	562.00	4 540.00
2009	38 325.00	573.00	4 561.00
2010	40 058.75	591.30	4 639.50
2011	41 062.50	605.90	4 704.30
2012	42 102.75	620.50	4 726.00

Source: Own elaboration based on data from Secretaría de Desarrollo Social (2013).

In Mexico -according to Article 115 of the Political Constitution- municipalities oversee cleaning, collection, treatment, and final disposal of waste. However, Mexico has experienced a noticeable change in public services, as more and more private services replace them. This includes the potable water supply, street lighting, and waste collection services (Couto Benítez et al., 2012). The participation of private sector has become an alternative solution to the problem of waste management, mainly in urban areas (Couto Benítez et al., 2012). Some studies address the population's willingness to pay for the trash collection system, as well as the factors that influence this decision (Kayamo, 2022; Koford et al., 2012; Song et al., 2016).

The studies on USW management are focused on urban areas which have a large population (in Mexico urban is upper than 15,000, and rural is below 2,500 inhabitants, in between: semi-urban). Nevertheless, these results are not likely to be applicable in semi-urban areas, as they are smaller (Friesen-Pankratz et al., 2011).

Therefore, there is a lack of information on USW collection and final disposal in rural and semi-urban areas, and also about the factors that incentive these inhabitants to acquire a waste collection service (WCS). For that reason, the purpose of this study is to determine the socioeconomic factors associated with the willingness to pay in order to create an integral solid waste management system (ISWMS) in semi-urban cities in Yucatán.

2 Materials and Methods

A quantitative approach with non-experimental design and cross-sectional type was used in this study by analyzing descriptive and inferential statistics through a truncated regression econometric model (Tobit). The data was collected in only one period between January and March 2021.

The design of the study considered having spatial representativeness of the semi-urban cities in municipalities in the state of Yucatan[3], those were selected according to their spatial distribution. The state was divided into six areas, considering the central, the northeast, northwest, southeast, and southwest areas. The municipalities selected according to the criterion of representativeness were: Halacho, Izamal, Muna, Peto, Tekax, and Tizimín, and the semi-urban cities selected inside them are their municipal seats; both are reported in Figure 2: municipality full colored and dot semi-urban city.

The sample size was calculated for each municipality seats with 95% confidence, 10% of error and, the positive response of 90% and negative response

[3] Yucatán has 106 municipalities.

of 10%. A total of 1,144 interviews were collected (Table 2), which were supplied and answered physically and personally (face to face), contemplating the informed consent regarding the use of the information and all the security and distance measures to avoid the spread of COVID-19.

The instrument used in the present study was a household survey, which was made up of a total of 6 sections that included: sociodemographic aspects of the household members, information related to the principal and secondary economic activities they carry out, elements about the physical characteristics of the home, the public policy programs that the home receives, the physical assets that the family has, and a section related to the generation of solid urban waste. All the information was captured and stored in spreadsheets and later imported into the STATA 17® statistical software for descriptive and econometric statistical analyzes.

Table 2. Sample size of study area

Municipality	Inhabitants	Sample size
Halacho	4,747	208
Izamal	9,640	206
Muna	3,029	205
Peto	5,599	102
Tekax	9,606	210
Tizimín	17,705	213
Total		1,144

Source: Own elaboration based on INAFED (2021)

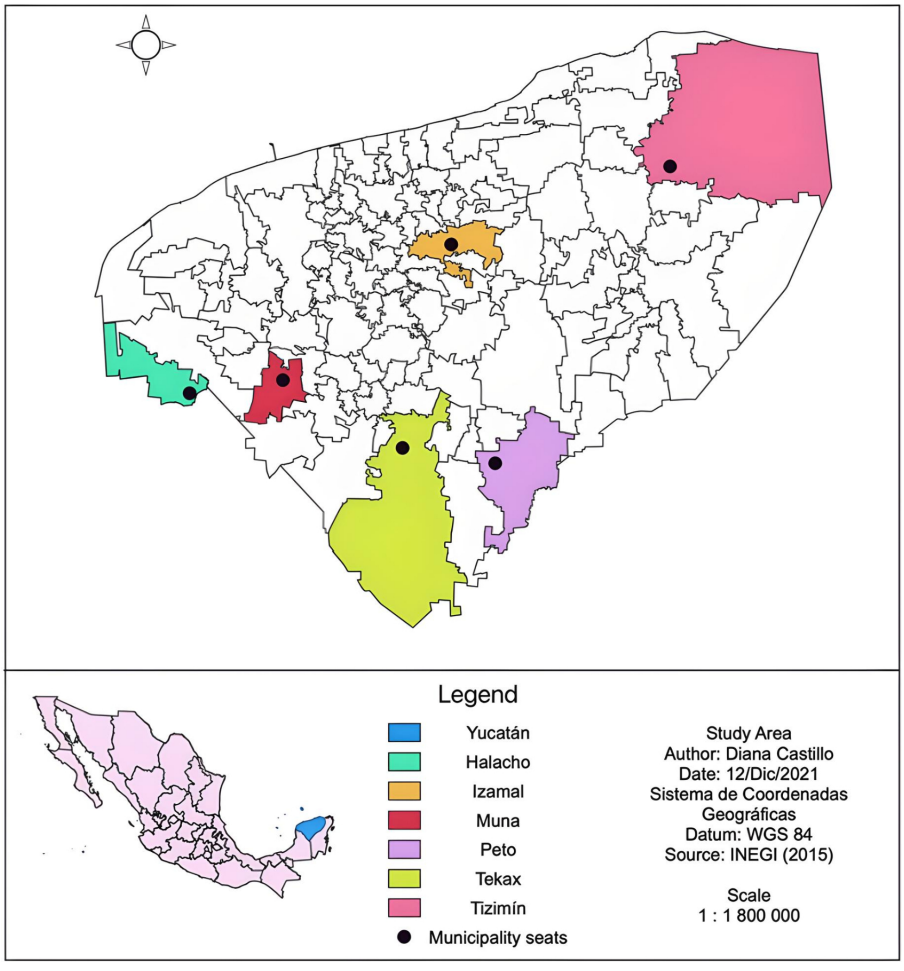

Figure 2. Study Area
Source: Own elaboration adapted from INEGI (2015).

2.1 Economic valuation method

The declared preferences method was used to estimate the total willingness to pay for the creation of an integral urban solid waste collection system. In particular, the contingent valuation method (CVM) was used, which offers a more direct approach to the interviewee (Tietenberg and Lewis, 2018). A CVM method provides information concerning WTP distribution for a proposed change in an environmental good (in this scenario, a reduction of pollution generated for the urban solid waste), and its goal is to measure an individual's monetary value for this item. The act of valuation implies a contrast between two situations, one with the item and one without it, therefore the answers reveal either an upper bound (in the case of a "no" answer) or a lower bound (in the case of a "yes" answer) (Tietenberg and Lewis, 2018; Carson and Hanemann, 2006).

The theoretical background of the method is composed by the structure of the utility function (Ferreira and Marques, 2015). The CVM relays on the survey response probability under the assumption that an individual maximizes her utility, the cumulative distribution function of WTP, G_c, and the corresponding probability density function, g_c, depends on the form of the survey questions (Hoyos and Mariel, 2010). We use an open-ended question format where individuals were asked to state their maximum WTP directly, A, the probability that the individual's WTP is equal to A, is:

$$Pr\left(WTP = A\right) \equiv g_c\left(A\right) \tag{1}$$

Obtaining the WTP distribution for an open-ended question format assumes a linear regression on some covariates (Zy) and a normally distributed random term (ε), so that WTP is also normally distributed (Hoyos and Mariel, 2010):

$$WTP = \mu_{WTP} + \varepsilon = Z_y + \varepsilon \tag{2}$$

2.2 Specifications of the Tobit censored regression model for WTP ($)

A monetary value of the willingness to pay (WTP) of the interviews was obtained. However, this dependent variable presents a particular characteristic as it is "left" censored in 0 for all the responses of the individuals who decided not to be WTP, in such a way, there is no charge for this situation. Additionally, it is also censored to the "right", since values greater than zero in the WTP have a limit of $ 200 MX[4], that is, none of the interviewees were WTP more than $ 200 MXN per month for the creation of ISWMS.

Therefore, the Tobit model (Tobin, 1958) is the most suitable alternative to the ordinary least squares regression model (OLS). The lack of ability to recognize the censorship in the distribution of the responses on the OLS model causes inconsistent and biased estimation parameters (Del Saz-Salazar et al., 2020; Maddala, 1983).

The Tobit regression model can be defined as follows:

$$y_i^* = x_i^{'}\beta + \varepsilon_i \tag{3}$$

Where y_i^* is the dependent latent variable, x_i, is the i-th row of n $\times$ (p+1) data matrix X with p explanatory variables, β is a (p+1) $\times$ 1 vector of coefficients and ε_i is the error term which is independently distributed with mean 0 and variance σ^2. There are different types of censoring such as left, right, double, centrally, and progressively (Toker et al., 2021).

The estimation of the Tobit model is now essentially on the level of ordinary linear regression (Greene, 2018), where the log likelihood for the censored regression model is:

$$\begin{aligned} \ln L = & \sum_{y_t>0} -\frac{1}{2}\left[\ln\left(2\pi\right) + \ln\sigma^2 + \frac{\left(y_i - x_i^{'}\beta\right)^2}{\sigma^2}\right] \\ & + \sum_{y_t=0} \ln\left[1 - \Phi\left(\frac{x_i^{'}\beta}{\sigma}\right)\right] \end{aligned} \tag{4}$$

Where the two parts correspond to the linear regression for the nonlimited observations and the relevant probabilities for the limit observation respectively (Greene, 2018).

[4]Exchange rate $ 20.73 mexican peso by $ 1 US dollar.

3 Results

The social, economic, and demographic characteristics of inhabitants and their households (HH) are reported in Table 3, were 41% of the household head is a man, the age average is around 50, and most of them (57%) speak local language: Maya. Most of the heads of household haven't finished high school (8.78 years of study). The annual income is around $ 2,720 US dollar per-capita.

Figure 3 identifies the urban solid waste generated with greater frequency in the interviewed households, the following stand out: bone and animal skin remain (93.53%), PET bottles (93%), food wrappers (92.48%), cleaning products (92.3%), food scraps (90.38%), light bulbs (89.07%), plastic in general (87.3%), cans (84.23%), toilet paper (83.3%) and, wood (82.25%). There is great value in recycling or the circular economy markets within the waste generated by households such as PET, cans, wood, and food wrappers. This factor is vital since the integral waste management system must consider reusing this type of waste.

Table 3. Sociodemographic characteristics of households

Variable	Mean	Standard deviation
Household head		
Sex (1=man)	0.41	0.49
Age	49.70	17.01
Speaks maya (1=yes)	0.57	0.49
Schooling years	8.78	4.01
Households' characteristics		
Family size	2.51	1.54
Number of rooms	2.00	1.06
Has a cellphone (1=yes)	0.89	0.31
Has a tricycle (1=yes)	0.36	0.48
Has a car (1=yes)	0.14	0.35
Anual total income ($MXN)	56,385.78	66,114.94

Source: Data collected, n= 1,144 households

Figure 4 presents the distribution of the USW generated in the households interviewed by their destination. As it is known waste collection handles some of the USW, however, the final disposal of other waste is burnt, sold, recycled, composted, used for animal food, given away, and dumped in landfills, streets, wells, and ground holes. According to the results obtained in the private dwellings, the following elements can be highlighted:

- Trash burning: The 24% of household burn toilet paper; the 24%, wood or gardening wastes; the 17%, food wrappers; the 16%, cardboard; and the 9%, domestic products.

- Waste collection: The 86% of households dispose light bulbs for trash collection; the 81%, domestic products, the 74%, toilet paper, the 73%, food wrappers; the 65%, tetrapak; the 58%, plastic in general; the 56%, glass; the 54%, medicines; the 59%, cans; the 47% of batteries; the 44%, home appliances; the 41%, cardboard; the 40% pet bottles; to a lesser degree, other.

- Sales: the households interviewed reported selling some of their waste to the USW. The 22% sale pet bottles; the 19%, metal; the 15%, cans; the 11%, aluminum; the 6%, plastic in general; and the 4% tetrapak.

- Compost: USW are useful to produce compost. The 3 USW mainly used for this purpose are wood or gardening wastes, in the 20% of households; manure, in the 11% and lastly food scraps, in the 7%.

- Animal food: USW can be used as animal food, especially in rural households that raise backyard animals. The main 3 used for this are bone and animal skin remaining the 60% of the households, food scraps, in the 49% and nixtamal in the 9%.

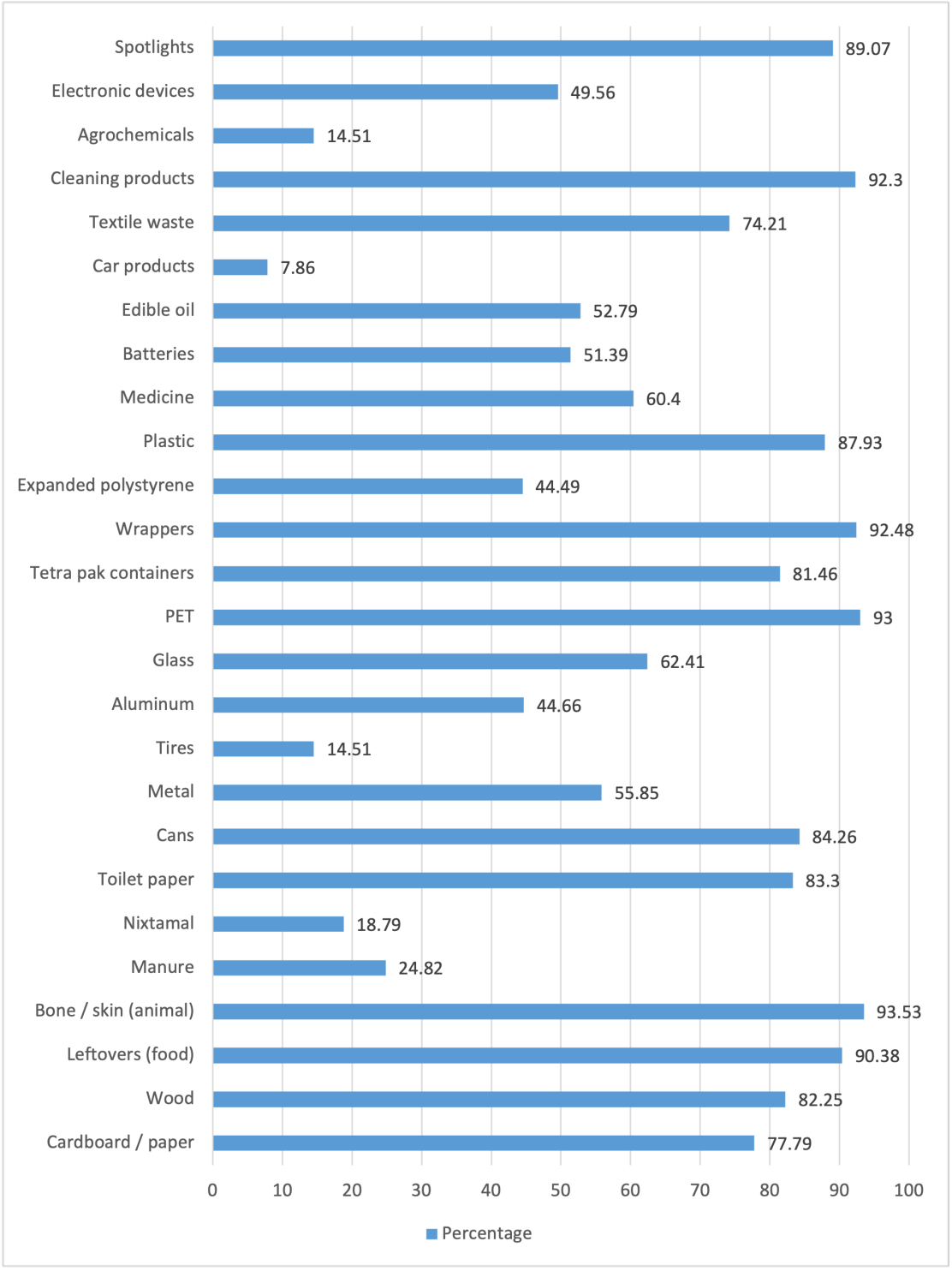

Figure 3. Percentage of households that generated Urban Solid Waste
Source: Own elaboration from data collected

In the description of the groups by their willingness to pay for creating an Integral Urban Solid Waste collection system in the municipalities, the results were as follows: 69.75% of the households interviewed declared they were willing to pay. The average payment amount is 17.65 Mexican pesos (0.85 US dollar).

The sociodemographic aspects that make the households different for their willingness to pay are described in Table 4. The results show that Mayan speaking (t = 3.33), years of education (t = 2.44), number of rooms in the house (t = 4.99), possession of a cell phone (t = 2.59), tricycle (t = 4.38) and a car (t = 3.89) make these groups different. In this sense, it is observed that households where the Mayan language predominates in general, are not willing to pay, as well as households that present fewer physical assets of the household.

The mean of WTP varies from one municipality to another. It is possible to observe in Figure 5 that in Muna, the WTP is barely above 10 pesos and is the lowest of all municipalities studied. While Halacho and Tekax are below 15 pesos, but up to 10. The WTP in Peto is above 15, but below 20 pesos. The WTP in Izamal is over 20 pesos, but the highest mean of WTP is in Tizimín, with 26.90 pesos.

The following Figure (6) shows the supervenience rate for more detailed information where the frequencies of occurrence of the remaining monetary value assigned can be observed by the interviewees.

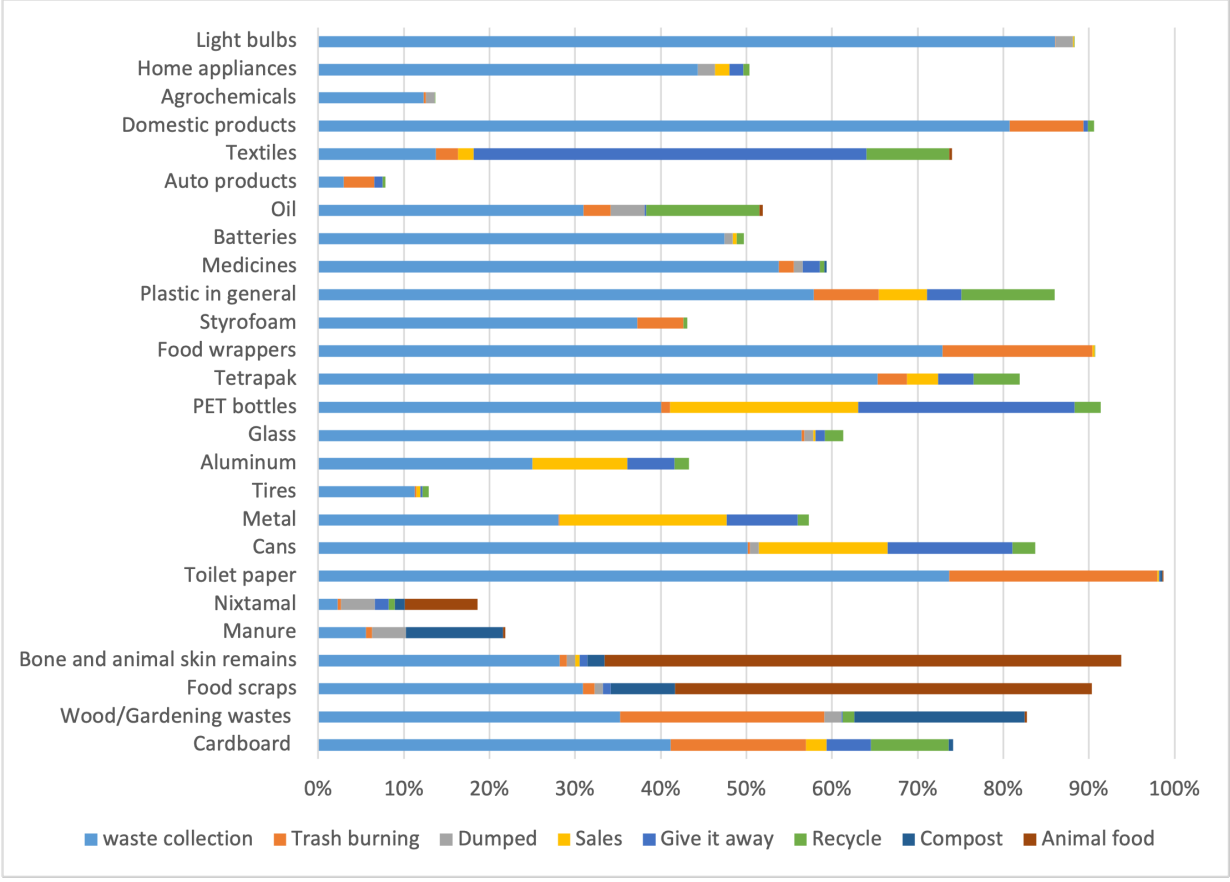

Figure 4. Destination of urban solid waste generated by households (%)
Source: Own elaboration from data collected

Households that declared not being willing to pay for an integrated solid waste collection system agreed on the following reasons:

- There is insufficient household income.
- There is no habit of paying for garbage collection.
- It is an additional expense for the home.
- There is already a free collection of waste.
- Distrust on the part of consumers because the current system does not function properly.

With the evidence of the descriptive information, the Tobit model was applied to identify the socioeconomic factors that influence the probability of a more significant monetary amount in people's willingness to pay. In total, six statistically significant variables were identified. Some of those variables are on the one hand; speaking Mayan by the head of the household and having a tricycle at home as an asset reduces the probabilities of making a higher payment. On the other hand, the years of education and variables associated with material improvements in the house, such as a more significant number of rooms, having a cell phone and a car, positively affect the probabilities of making a greater willingness to pay. The results are shown in Table 5.

Table 4. Sociodemographic aspects of the households interviewed regarding their WTP

Variable	Household is willing to pay (n=798)	Household is not willing to pay (n=346)	|t|
Household head			
Sex (1=man)	0.41	0.42	0.44
Age	49.34	50.52	1.08
Speaks maya (1=yes)	0.54	0.65	**3.33**
Education	8.97	8.34	**2.44**
Hosehold aspects			
Family size	2.48	2.57	0.91
Number of rooms	2.10	1.76	**4.99**
Has a cellphone (1=yes)	0.90	0.85	**2.59**
Has a tricycle (1=yes)	0.32	0.45	**4.38**
Has a car (1=yes)	0.17	0.08	**3.89**
Anual total income per cápita ($MXN)	3,025.23	2,729.95	1.33

Source: data collected.

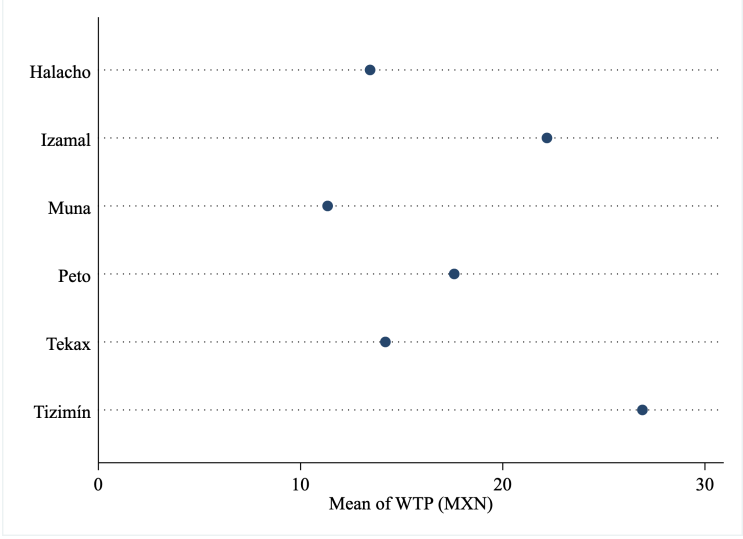

Figure 5. Mean of WTP from municipalities studied
Source: Own elaboration from data collected

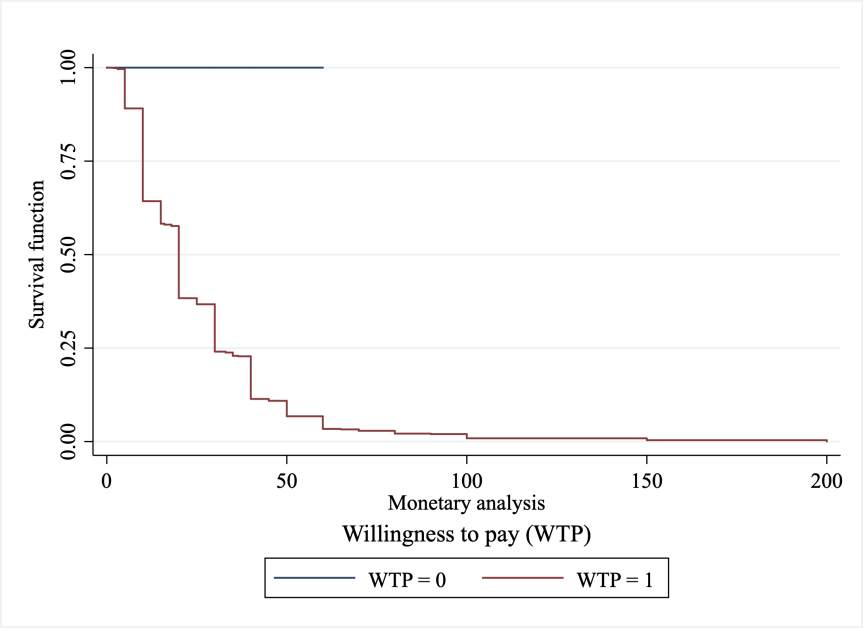

Figure 6. Survival estimates of WTP
Source: Own elaboration from data collected

4 Discussions

The results of academic research are useful by regional authorities to establish IUSWM plans and programs capable of meeting regional waste management demands (Gidarakos et al., 2006). However, there is a lack of studies on how rural populations manage their solid waste (Taboada-González et al., 2013). Findings from existing studies indicate that local government waste collection is deficient since a significant part of this population lacks the service (Del Carmen-Niño et al., 2019). There are also informal trash collection systems in rural areas, for which the residents must pay a fee (Aljaradin et al., 2015).

In addition, the results of the present study reveal that rural dwellers use organic waste to feed their animals or in the production of compost, (Del Carmen-Niño et al., 2019; Juárez López, 2009); this tendency shows potential for the application of the component of re-utilization of USW. Furthermore, some households use trash burning as a cultural practice or because there is no trash collection available (Del Carmen-Niño et al., 2019; Friesen-Pankratz et al., 2011), which is one of the practices that IUSWM try to avoid since waste burning is a path for air pollution. A high percentage of food wrappers are notable (92.48%), as it has been observed by other studies in different countries, this practice is related to the change in consumption patterns (Gidarakos et al., 2006).

Previous studies reveal that the WTP for an urban solid waste recollection system is related to the value that inhabitants assign to the quality of the environment in their community, and other socioeconomic elements as income, gender, age, level education, family size, offspring, environmental ethics, and confidence in government (Ibarrarán et al., 2003; Quispe Mamani et al., 2020). In this case, the associated factors include not speaking Mayan, higher number of assets and more rooms in the house.

Nonetheless, there is a 69.75% of the households interviewed willing to pay, which represents an opportunity for the government to establish appropriate plans and programs of Urban Solid Waste Management in partnership with a private entity. This percentage is lower than the one presented by Song et al. (2016), which obtained 85.5% positive responses towards WTP in a study conducted in Macau, China.

It was possible to establish the mean willingness to pay in the study area, which was 17.65 Mexican pesos (0.85 US dollar) per household, significantly lower results than those obtained by Ferreira and Marques (2015) in Portugal (2.59 euros) or that reported by Koford et al. (2012) in the United States ($2.29 USD), as well as the 10.16 soles estimated by Colquehuanca Vilca et al. (2020) in Peru, the $4.79 USD obtained by Song et al. (2016) in China and Kayamo (2022) in Ethiopia with $0.62 USD per person. The variation might be linked to the different income between countries, an element that exceeds the scope of this study.

Table 5. Results of the Tobit regression model

Variable	Coefficient	Std. Error	z	P>|z|
Household head				
Sex (1=man)	1.99	1.76	1.13	0.259
Age	0.05	0.06	0.96	0.337
Speaks maya (1=yes)	-3.74	2.00	**-1.87**	0.022
Schooling years	0.43	0.25	**1.68**	0.093
Household aspects				
Family size	0.92	0.57	1.61	0.106
Number of rooms	4.05	0.81	**5.00**	0.000
Has a cellphone (1=yes)	10.95	2.95	**3.70**	0.000
Has a trycicle (1=yes)	-7.52	1.86	**-4.04**	0.000
Has a car (1=yes)	8.00	2.46	**3.25**	0.001
Constant	-12.19	5.81	2.10	0.036

n=1,144; uncensored=800, left-censored=341, right-censored=3; Chi^2=100.09 prob>Chi^2=0.000
Source: Own elaboration from data collected

5 Conclusions

The contingent value method applied to implementing a solid waste collection system in semi-urban communities in Yucatán was successfully applied in this study. Its effectiveness as a method of direct assessment of the change of a situation involving municipal solid waste is tested in the rural and peri-urban cities in Yucatan, Mexico.

The methodology used allows the establishment of market-based solutions that reconcile the ability to pay of the actors involved; however, since they are directly associated with public service (solid waste collection), it is necessary to develop complementary public policies that address the proper disposal of waste, as well as its reduction. The results of this study contribute to better understanding the relationship between the inhabitants of growing cities and to be able to address these problems that have economic, social, and environmental consequences.

The socioeconomic factors that affect the willingness to pay and that were statistically significant allow us to approach the household profile that generates solid urban waste. This information can help future studies that allow establishing an optimal price for the municipal solid waste collection system, also considering the following elements described below to guarantee the financing and economic sustainability of the system. Although there are cultural and social elements rooted in solid waste collection, this integrated system may be accompanied by other types of economic incentives to modify consumers' behavior towards something more beneficial for the environment, such as the homes' income. An example of the that could be the payment of the proper disposal of waste with high recycling value.

In other countries, a proper public-private urban solid waste management partnership can result an effective strategy to solve the USW management problems Aliu et al. (2014); Bhuiyan (2010); Rode (2011).

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Conflicts of interest

The authors declare that they have no conflict of interest.

Author Contributions

Conceptualization, FIHC; formal analysis, FIHC; research, FIHC and DECL; methodology, FIHC; monitoring, validation and visualization, FIHC, DECL, JBG and MPMG; writing-original draft, FIHC, DECL, JBG and MPMG; acquisition financing, MPMG; writing-review and editing, FIHC, DECL and MPMG.

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