

## Impacts of environmental education based on the classification of household solid waste



### Impactos de la educación ambiental basado en la clasificación de los residuos sólidos domésticos

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#### Abstract

In Quevedo, the Guayacán parish is known for its commercial activity in the residential area, waste disposal does not include

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classification at the source, and the municipal temporary collectors located in each sector are not sufficient for the existing inhabitants. Evaluating the environmental education plan, according to the level of knowledge, attitudes, practices, moral obligations and government policies, is the objective of the research. 352 inhabitants were surveyed by means of a questionnaire with two sections of questions: demographic information and household waste management. The environmental education plan that fosters an environmental attitude, ecological awareness and environmental sensitivity was implemented in 53 volunteer households, with house-to-house visits. The per capita generation of 0.85kg/inhab\*day and 64.35% of the generation corresponds to organic waste according to the characterization phase.

**Key words:** Waste sorting, Education level, Occupational occupation, Environmental awareness, Practical workshops.

### **Resumen**

En Quevedo, la parroquia Guayacán es reconocida por la actividad comercial en el área residencial, la disposición de los residuos no incluye clasificación en el origen y los colectores temporales municipales ubicados por sectores no son suficientes para los habitantes existentes. Evaluar el plan de educación ambiental, según el nivel de los conocimientos, actitudes, prácticas, obligaciones morales y políticas gubernamentales, es el objetivo de la investigación. Se encuestó a 352 habitantes mediante un cuestionario con dos secciones de preguntas: información demográfica y el manejo de los residuos domésticos. El plan de educación ambiental que fomenta una actitud ambiental, conciencia ecológica y sensibilidad ambiental se implementó en 53 hogares voluntarios, con visitas casa a casa. La generación per cápita de 0,85kg/hab\*día y el 64,35% de la generación corresponde a residuos orgánicos según la fase de caracterización.

**Palabras clave:** Clasificación de residuos, Nivel de educación, Ocupación laboral, Sensibilización Ambiental, Talleres prácticos.

## **Introduction**

Solid waste is the by-product of human activity since the dawn of humanity. Every day they increase in quantity and variety as a consequence of the increase in human population and technological and industrial development (Leiton & Revelo, 2017). In this regard Urbina et al (2019) mention that "the high levels of consumption, associated with the processes of population growth and urbanization, have increased the generation of household solid waste in urban spaces. For this reason, this problem is addressed in terms of the environmental impacts and consequences it causes".

According to the World Bank report every year 2010 million tons of municipal solid waste is produced worldwide, the volume is expected to increase by 2050, which poses enormous challenges for municipal waste disposal (Wang, Dong, & Yin, 2018).

In Ecuador, each inhabitant of the urban sector produces on average 0.58 kilograms of solid waste per day. The daily collection of solid waste is around 12,897.98 tons, corresponding to the year 2016 (INEC, 2018). Of the total waste collected per day, 11% is in a differentiated manner between organic and inorganic waste from the source (Instituto Nacional de Estadística y Censos, 2015). Environmental education involves a process of raising awareness of emerging socio-environmental processes, which mobilizes citizen participation in decision-making (Hernández, 2014). The challenge of environmental education is to ensure that human beings incorporate into their lives knowledge, attitudes, habits and values that allow them to understand and act in environmental conservation, (Pinilla, 2015).

The purpose of this research is to determine the impact of the implementation of an environmental education plan regarding the classification of solid waste at the source, as a strategy to improve solid waste management by promoting environmental awareness among the inhabitants of the El Guayacán neighborhood through the acquisition of environmental knowledge and attitudes.

## **Materials and methods**

The research was conducted in the town of El Guayacán (Figure 1) located in the canton of Quevedo in the province of Los Ríos. According to the last population and housing census conducted in

2010, it has a population of 4,236 inhabitants. An exclusive area was selected with households of compact organization and close to temporary storage collectors provided by the Decentralized Autonomous Government of Quevedo.

A total of 352 surveys were conducted with residents of the Guayacán parish to analyze demographic data (gender, education level, and occupation) and the management of municipal solid waste (MSW) in the household, according to 24 questions related to solid waste management in households, knowledge (10), attitude (3), practice (5), moral obligations (3), and government policies (3). Aspects that show the level of knowledge, attitude, practice, moral obligations and government policies of the inhabitants towards the reduction and classification of solid waste, recycling and waste collection; each indicator of the response variables was coded as 1 and 0, for yes or no answers respectively. The Chi-square test was then applied to the results, which correlates the demographic characteristics of the citizens (level of education, gender and occupation) and the knowledge, attitudes, practices, moral obligations and government policies on the management of household solid waste. The significance level was set at 0.05 ( $P < 0.05$  considering as significant) (Zoroufchi Benis, Safaiyan, & Shakerkhatibi, 2018). In 59 volunteer households, urban solid waste was characterized as set out by the Ecuadorian Technical Standard NTE INEN 2841.2014- 03, which sets out the Environmental Management in Ecuador (Table 1). And per capita production was determined (Ruiz, 2015).

Based on the results obtained from the diagnosis, measures were established to help classify and make the best use of waste. The components of the Environmental Education Plan (PEA) consisted of five areas: awareness and sensitivity, knowledge and understanding, attitudes, skills and participation, which were subsequently evaluated in a non-formal educational process; with the implementation of direct contact actions with the participating actors; activities that help to change values and attitudes towards daily activities (Pinilla, 2015).

## Results

The results of the survey of the 352 inhabitants determined the main demographic characteristics of the study area: 45% are men and 55% are women. Regarding the level of education, 55% of those surveyed have a university degree, 44% have a high school education and 1% are illiterate. Finally, 13% of the respondents work in a government institution, while 56% are self-employed and 31% are unemployed. In reference to the management of solid waste (SW) generated by phases in the initial evaluation, the lack of classification in the generation of the 59 households was evidenced. There are two storage spaces: inside the homes without protective measures for hazardous waste and temporary storage in public containers located next to the sidewalks of public roads, where waste from different households is mixed and there is no collection of liquids. Waste is collected and transported twice a day (morning and afternoon) from Monday to Sunday. There is no waste treatment or utilization, and final disposal is carried out in the emergency pooled cell, which is currently collapsed. These problems are more severe in developing countries, where waste collection and integrated management operations do not occur at all or not enough (Pakpour, 2014).

The results highlight the knowledge about the composition of garbage generated in the household (86%), reduction of waste generation (74%), valuable solid waste (68%), recyclable waste (96%) and the economic and environmental benefits of recycling (80%). Regarding the effects on health caused by the misclassification of solid waste (91%), the reduction of environmental pollution (87%), the reduction of waste of resources (81%) and the reduction of greenhouse gas emissions due to the implementation of selective waste collection (75%), 63% are aware that they do not know the benefits of recycling. While 63% are aware that there are no waste separation containers in the El Guayacán neighborhood. The attitude of support for the proper sorting of waste is supported by 86% of respondents and the delivery of segregated waste to collection agents by 78%.

However, in practice, only 53% reported sorting solid waste at home, 52% responded that their family does not always sort MSW, 77% reported that their friends do not sort waste, and only 30% of respondents sell segregated waste to itinerant waste buyers.

According to the results, 67% of the inhabitants surveyed are satisfied with the current waste collection service provided by the municipality and 16% go to the municipality for waste problems. Regarding moral obligations 64% of the respondents stated that it is against their moral principles not to sort MSW, 68% have an obligation to sort their household waste and 67% feel guilty if they do not sort waste. And with respect to government policies, respondents know that residents who sort solid waste can receive subsidies by the government and can get incentives by the community (27% and 28% respectively), 27% understand that people who fail to comply with the rules of collection and separation of household solid waste should be sanctioned by the government. Since profitability and success in the management of household waste, is through changes in attitudes and behaviors; as well as public education and encouragement of citizens to participate in the recycling process, as part of citizen participation in source separation (Babaei, Alavia, Goudarzia, & Ahmadie, 2015).

Based on the Chi-square test, the correlation between demographic characteristics of citizens such as level of education, gender and occupation; and knowledge, attitudes, practices, moral obligations and government policies on the management of household solid waste; it was shown that for the knowledge of waste composition is dependent on the type of governmental occupation of the citizen (PC1 p-value  $0.010 < 0.05$ ); but not dependent on gender (PC1 p-value  $0.070 < 0.05$ ); neither on educational level (PC2 p-value  $0.132 < 0.05$ ). While knowledge about recyclable waste presents a significant association with higher education (PC5 P-value  $0.014 < 0.05$ ).

Executing solid waste sorting at home correlates with female gender (PC1 p-value  $0.019 < 0.05$ ) and with education level (PC1 p-value  $0.026 < 0.05$ ). Moral obligations reflected in waste management, depends on gender (PC3 p-value  $0.05 = 0.05$ ).

The implementation of training and participatory workshops included talks on the types of waste, classification, use and effects of improper disposal. The characterization of each household was part of the practical activities developed. The average per capita production of 0.85 kg/inhab\*day was higher than the 0.75 kg/inhab\*day determined in the Mundo Verde commonwealth study (2014). The type of waste that stands out is organic waste with

64.35% of the total weight. By highlighting the increase in the considered areas of evaluation after the implementation of the education plan. With greater weight in the Moral obligations with 79%, predisposition to support public policies or ordinances in favor of improving the management of RS with 72.67%. This is supported by the 22.67% increase in the attitude to apply knowledge, which increased by 22.50%. However, it is evident that the greatest difficulty is presented with the practical part, since in the application of knowledge, the population does not have a public system that motivates, manages and encourages the correct application of MSW management. In assessing the improvement of knowledge on characterization of municipal solid waste and household waste, behaviors in a megacity in northwestern Iran, slightly improvement was evidenced with respect to the level of education, so that people with relatively high level of education had more knowledge of MSW than those with primary education level. The impact of respondents' occupation revealed that people with government occupations were more aware than the unemployed or employed and also had more tendencies to approach municipal authorities about waste problems. Noticing that the knowledge and awareness of government employees towards recycling programs and waste management system are higher than the self-employed and unemployed (Zoroufchi Benis et al 2018).

In the present study, similarities were obtained in the correlation between the demographic characteristics of the citizens and the knowledge, attitudes, practices, obligations, morals and governmental policies on the management of household solid waste whose results indicated that people with a higher level of education had more knowledge about SW than those with a lower level of education since their knowledge was improved after years of study. In addition, a higher level of education had positive influences on the willingness to separate waste. These results corroborate the findings of previous studies, indicating that the level of education plays an important role in the SR-related behavior of citizens. Generally, it can be said that people with high educational levels have more general knowledge which, consequently, they are supposed to act positively regarding the environment (Al-Khateeb, Al-Sari, & Anayah, 2017). The impact of respondents' occupation showed that people working in a government institution were more

aware than the unemployed or self-employed. Regarding the relationship of gender with waste separation behavior was statistically non-significant (88.6% of females and 81.8% of males are aware of solid waste composition) unlike the study of (Zoroufchi Benis, Safaiyan, & Shakerkhatibi, 2018). However, females were more willing to sort solid waste. In the case of practicing solid waste sorting at source the participation of females (59.1%) was higher than those of males (46.5%) indicates that the gender association with waste sorting practice was statistically significant. Based on the results, women's participation has been shown to be reasonably effective in source separation activities, and in general, women are more likely to recycle. In order to achieve the acquisition of environmental knowledge, the development of education and ethics is necessary, as indispensable processes in shaping awareness in this regard (Varona, 2018).

## **Discussion**

The development of practical, participatory and dynamic trainings established in the environmental education plan increased the volunteers' knowledge, attitude, moral obligations and practice, reflecting a positive impact of 33.74% increase in knowledge, attitude, practice, moral obligations and government policies.

It is imperative to apply incentives to reduce the degradation of environmental factors caused indirectly by the mixing and inadequate disposal of solid waste in homes, temporary collectors and later in the emerging cell of the canton of Quevedo. Therefore, it is necessary that environmental education plans are implemented with the support of public policies that integrate the respective incentives and sanctions.

The classification of solid waste at the source (households) represents a greater opportunity for waste recovery; obtaining organic fertilizer due to the high percentage of organic waste generated, and for recyclers, recycling cardboard, plastic and glass is more optimal. In addition, it contributes to the municipal collection and disposal system by reducing the volume that is dumped in temporary containers in the parish of El Guayacán.

The level of education, gender and type of work occupation, increase the impact of the environmental education plan; the statistically

significant correlation of the Chi-square analysis, highlighted that people with a higher level of education play an important role in the behavior of the inhabitants, as they knew more about solid waste. As well as occupation showed that people working in a governmental institution were more aware of the knowledge of waste and for the practice, the female gender was more willing to sort solid waste at the source.

The environmental education plan is a tool that trained the inhabitants and raised awareness among the inhabitants of the El Guayacán neighborhood about sorting solid household waste at the source. It increased the predisposition to apply the classification through a change of attitude and environmental sensitivity.

## References

- Al-Khateeb , A., Al-Sari, M., & Anayah , F. (Jan 31, 2017). Factors affecting the sustainability of solid waste management system-the case of Palestine. *Environmental Monitoring and Assessment*(93). Retrieved 07/27/2020 , from <https://link.springer.com/article/10.1007%2Fs10661-017-5810-0>.
- Babaei, A., Alavia, N., Goudarzia, G., & Ahmadi, K. (September. 2015). Household recycling knowledge, attitudes and practices towards solidwaste management. *Resources, Conservation and Recycling*, 102, 94-100. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0921344915300331?via%3Dihub>.
- Hernández, M. (January 14, 2014). Environmental education for sustainable development. Challenges and perspectives. (D. D. Domínguez, Ed.) *Estudios del Desarrollo Social: Cuba y América Latina*, 1(3), 9.
- National Institute of Statistics and Census (2018). *Statistics on Economic Environmental Information in Municipal Decentralized Autonomous Decentralized Governments*. Retrieved on 11/26/2019, from <https://www.ecuadorencifras.gob.ec/segu.n-the-latest-environmental-information-statistics-every-ecuatorian-produces-058-kilograms-of-solid-waste-per-day/#>.
- Leiton, N., & Revelo, W. (2017). Integrated solid waste management in the company CYRGO SAS. *Tendencias*,

18(2). Retrieved 10/26/2020, from.  
[http://www.scielo.org.co/scielo.php?scrip  
t=sci\\_arttext&pid=S0124-  
86932017000200007&lang=es&fbclid=I  
wAR2XKE76eFtix-  
FVrTPFjKximRa5Rs9RkmQxwu\\_H\\_YZ MUP2JtSoely-  
27W4](http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0124-86932017000200007&lang=es&fbclid=IwAR2XKE76eFtix-FVrTPFjKximRa5Rs9RkmQxwu_H_YZ_MUP2JtSoely-27W4)

Ministry of Water and Environment Ecuador (2014). Study of Integrated Solid Waste Management - Commonwealth SUMAK KAWSAY.

Malmir , T., & Tojo, Y. (May 07, 2016). Municipal solid waste management in Tehran: Changes during the last 5 years. *Waste Management & Research*, 34:449- 456. retrieved on 09/15/202056, from <https://journals.sagepub.com/doi/10.1177/0734242X16632056>

Ecuadorian Technical Standard NTE INEN 2841. Environmental Management. Standardization of colors for containers for deposit and temporary storage of solid waste. Requirements Quito: Ecuadorian Technical Standard; 2014.

Pakpour, A. e. (2014). Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management*, 34, 980-986. Retrieved 09/15/2020 , from <https://www.sciencedirect.com/science/ar>.

Pinilla, M. (2015). *Proposal for environmental education that can contribute to the proper management of household solid waste in the urban sector of the municipality of Raquira - Boyaca*. Manizales: University of Manizales.

Ruiz R. (2015). Characterization of household solid urban waste generation in the Faja de Oro subdivision, in Coatzintla, Veracruz; Universidad Veracruzana.

Urbina , M., Zúñiga, L., & Fernández , I. (2019). Urban environmental management of the life cycle of household solid waste in the city of Holguín, Cuba. *URBAN NOTEBOOK. Space, culture, society*, 26(26).

- Varona, R. (2018). Community actions for the social management of environmental knowledge in the Edecio Pérez community in the municipality of Holguín. *General Journal of Information and Documentation*, 28(2), 477-488. Retrieved 15 09 2020 ,from <https://revistas.ucm.es/index.php/RGID/article/view/62835/4564456549060>
- Wang, Z., Dong, X., & Yin, J. (February 01, 2018). Antecedents of urban residents' separate collection intentions for household solid waste and their willingness to pay: Evidence from China. *Journal of Cleaner Production*, 173, 256-264.
- Zoroufchi Benis, K., Safaiyan, A., & Shakerkhatibi, M. (06 11, 2018). Municipal solid waste characterization and household waste behaviors in a megacity in the northwest of Iran. *International Journal of Environmental Science and Technology*, 4863 - 4872. Retrieved on 07/26/2020, from <https://link.springer.com/article/10.1007/s 13762-018-1902>.