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Measuring the generation of domestic waste: a statistical and legal approach. Case study: Riobamba

Medición de generación de residuos domésticos: un enfoque estadístico y legal. Estudio de caso: Riobamba

Medição da geração de resíduos domésticos: uma abordagem estatística e legal. Estudo de caso: Riobamba

Xavier Alejandro Guerra-Sarche [I]
xavier.guerra@espoch.edu.ec
https://orcid.org/0000-0002-5111-0977

Diego Vinicio Argüello-Parra [II]
diego.arguello@espoch.edu.ec
https://orcid.org/0000-0001-8940-1289

Carlos Xavier Oleas-Lara [III]
carlos.oleas@espoch.edu.ec
https://orcid.org/0000-0003-0308-9197

Correspondencia: xavier.guerra@espoch.edu.ec

Ciencias técnicas y aplicadas
Artículo de investigación

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I. Máster en Sistemas de Transporte, Ingeniero Mecánico, Docente Investigador Escuela Superior Politécnica de Chimborazo, Riobamba, Ecuador.

II. Magíster en Derecho Administrativo, Abogado, Docente Investigador Escuela Superior Politécnica de Chimborazo, Riobamba, Ecuador.

III. Magíster en Administración Marítima y Portuaria, Ingeniero en Comercio Exterior, Docente Investigador Escuela Superior Politécnica de Chimborazo, Riobamba, Ecuador.

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Resumen

El desperdicio mal administrado es un problema que aún no tiene una solución global, como en América Latina y Ecuador. Es imperativo contribuir a la comunidad científica con investigaciones relacionadas para tomar decisiones inmediatas; de lo contrario, la calidad de vida de estos sectores se ve seriamente comprometida. Este estudio analiza la producción de residuos domésticos, incluidos materiales reciclables y no reciclables en varias ciudades de Ecuador, especialmente en Riobamba, ubicado en el centro del país, y propone soluciones probables desde una perspectiva legal y logística. Además, este artículo científico propone una metodología estadística para medir estos desechos separados por materiales, basada en una medición semanal ponderada de desechos de una muestra de estudiantes en Riobamba. Su ingreso promedio, edad y situación de residencia se comparan con la producción de residuos con el objetivo de concluir las siguientes declaraciones. En Ecuador, al menos el 50% de todos los residuos domésticos están mal administrados y contribuyen negativamente al medio ambiente. Los hallazgos mostraron que aproximadamente una persona produce 1,5kg de desechos por semana, lo que significa altos costos para la Municipalidad para administrar estos materiales. Desafortunadamente, la mayoría de las ciudades, fábricas y empresas en Ecuador no tienen ningún sistema para reemplazar los desechos en la cadena de producción nuevamente.

Palabras claves: Metodología; generación de desperdicios; global.

Abstract

Mismanaged waste is a problem which do not have a global solution yet, such as in Latin America and Ecuador. It is imperative to contribute to the scientific community with related research to take immediate decisions; otherwise, the quality of life of these sectors are seriously compromised. This study analyses the production of home waste including recyclable and non-recyclable materials in several cities in Ecuador, especially in Riobamba located in the center of the country and proposes likely solutions from a legal and logistics perspective. Besides, this scientific paper proposes a statistical methodology to measure this waste separated by materials, based on a weekly weighted waste measurement from a sample of students in Riobamba. Their average income, age, and residence situation are compared with the waste production aiming to conclude the following statements. In Ecuador, at least 50% from all the home waste is mismanaged and contributes negatively to the environment. The findings showed that

approximately a person produces 1.5kg of waste per week, meaning high costs for the Municipality to manage these materials. Unfortunately, most cities, factories, and companies in Ecuador do not have any system to replace waste in the production chain again.
Keywords: Methodology; waste generation; global.

Resumo

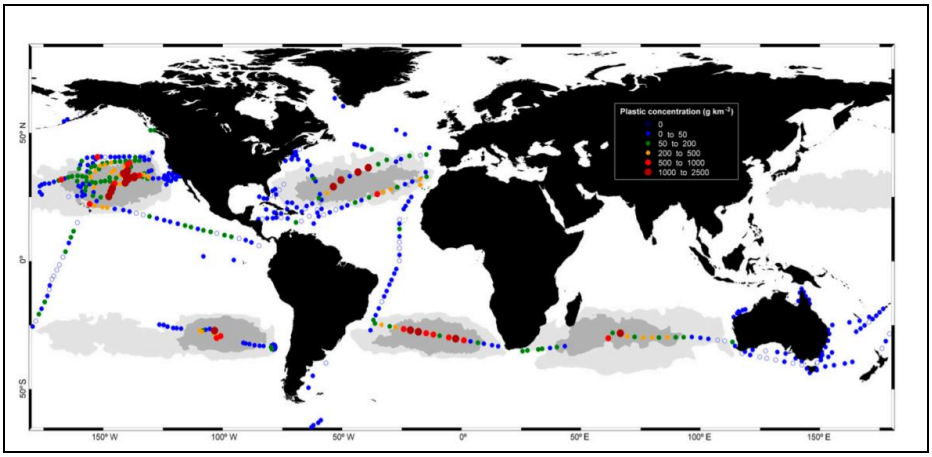
Lixo mal administrado é um problema que ainda não possui uma solução global, como na América Latina e no Equador. É imperativo contribuir para a comunidade científica com pesquisas relacionadas para tomar decisões imediatas; caso contrário, a qualidade de vida desses setores está seriamente comprometida. Este estudo analisa a produção de lixo doméstico, incluindo materiais recicláveis e não recicláveis em várias cidades do Equador, especialmente em Riobamba, localizada no centro do país, e propõe soluções prováveis do ponto de vista jurídico e logístico. Além disso, este artigo científico propõe uma metodologia estatística para medir esses resíduos separados por materiais, com base na medição ponderada semanal dos resíduos de uma amostra de estudantes de Riobamba. Sua renda média, idade e situação de residência são comparadas com a produção de resíduos com o objetivo de concluir as seguintes afirmações. No Equador, pelo menos 50% de todo o lixo doméstico é mal gerenciado e contribui negativamente para o meio ambiente. Os resultados mostraram que aproximadamente uma pessoa produz 1,5kg de lixo por semana, o que significa altos custos para o município gerenciar esses materiais. Infelizmente, a maioria das cidades, fábricas e empresas do Equador não tem nenhum sistema para substituir os resíduos da cadeia produtiva novamente.
Palavras-chave: Metodologia; geração de resíduos; global.

Introduction

Synthetic global plastic production began in 1907. In 1950 the world production grew approximately to 2 millions of Tons per year, and in 2015 this industry made 381 millions of tons of this material in this year (Geyer et al., 2017). In comparison, this production weight in 2015 is approximately equivalent to placing all the population of the Republic of Ireland (4.83 million people) onto one scale, assuming each people weights 80 kg, or just 2015 plastic mass would be enough to cover the whole Australian territory surface with LDPE plastic (Assuming, 50 microns

thickness, 1g/cm^3 density). In cumulative terms, by the year 2015, global plastic production has been reaching approximately 7823 millions of tons (Geyer et al., 2017), which would be enough 50 microns thick LDPE plastic layer to cover 30% of the Earth or the entire Mars planet. On of the main issues with plastic, is its long-term breakdown period which could last to hundreds or even millennials depending on the type of plastic and surroundings conditions. The lack of thermal oxidation rate makes this decomposition process even slower in the sea, compared to the same process on land, which represents a huge concern for the Earth environment (Elias, 2018). This fact has created considerable plastic concentration in the oceans, not only on the water surfaces but also in more deeper levels, as it can be observed in Figure 1.

Figure 1: Global plastic concentration in the oceans worldwide



Source: Cózar et al., 2014

According to Figure 1, the plastic concentration surfaces globally are shown. Dot color meanings are displayed on the map. Blue, green, yellow, red, and wine-colored dots represent the plastic concentration on water surface in (g/km^2). Dark and light gray areas represent inner and outer accumulation zones, respectively. As it can be observed there are important polluted areas in all the oceans worldwide, especially in Pacific and Atlantic oceans (Cózar et al., 2014). As it can be observed in Figure 2 and

Figure **3**, the garbage and plastic problem is a serious issue of global concern.

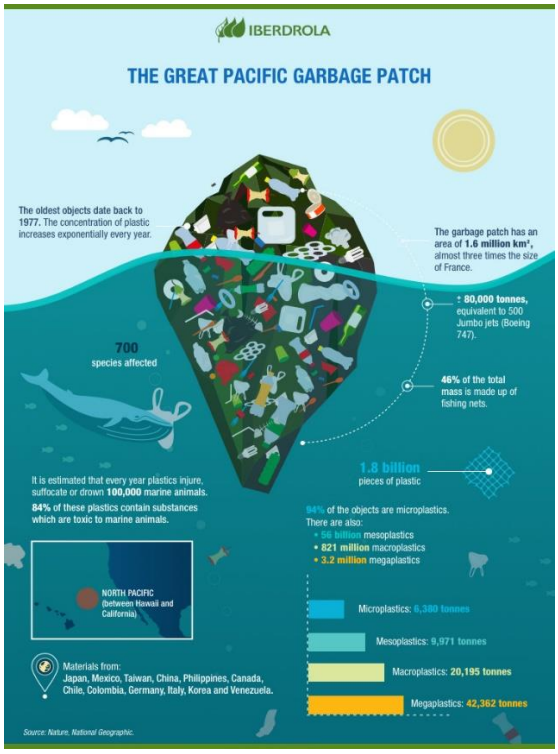
The great Pacific garbage patch (GPGP) has an extend of 1.6x10^6 km^2, equivalent to approximately twice the area of Texas, or five times the surface of Ecuador. This fact represents a

huge problem to the marine life and environment equilibrium, for instance, many animals like seals, fish, or pelicans have been found dead trapped in garbage or with their stomachs full of it (Snowden, 2019).

Figure 2: Great Pacific Garbage Patch

Source: Snowen, 2019

Figure 3: Great Pacific Garbage Patch information

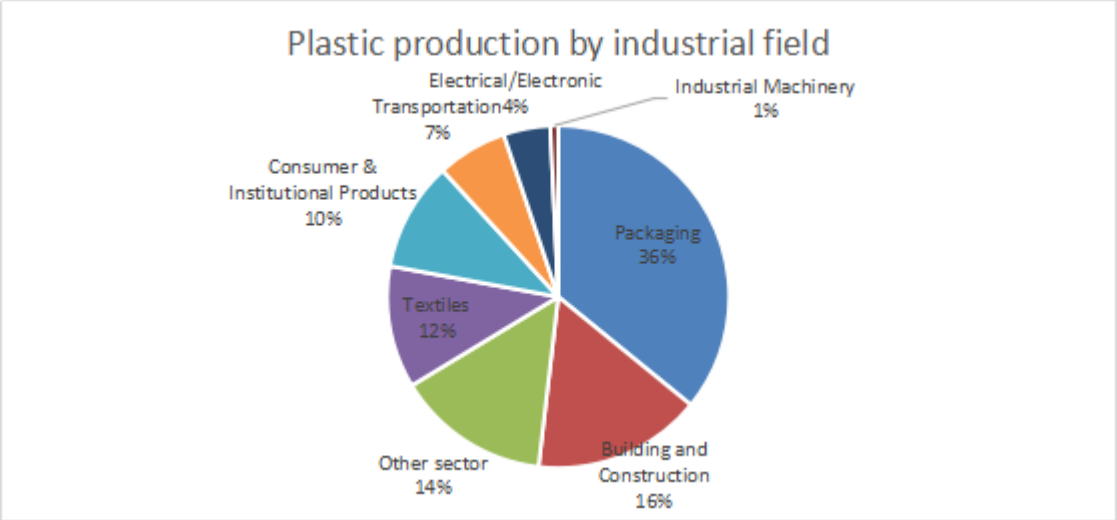


Source: Iberdrola, 2020

In

Figure **3** it is displayed many facts about the GPGP, for instance, there are 80 000 tons of garbage, there are 1.8 $x10^9$ pieces of plastic which 94% are microplastics (just a few mm's in diameter), their countries of origin are Japan, Mexico, Taiwan, China, etc. (Iberdrola, 2020). It is said that from the total cumulative plastic production, more than 50% directly or indirectly ends as landfill or discarded. In the year 2015, from the total yearly plastic production, main industrial sector which used plastic for their products were packaging, building and construction, textiles, consumer & institutional products, transportation, electrical/electronic, industrial machinery, and other undefined sectors, as it is displayed in Chart 1.

Chart 1: Plastic production by industrial field



Source: Geyer et al.,2017

Even though countries like China, United States, Germany, Brazil, Japan, etc. represent the biggest countries producing plastic waste, it does not mean that they contribute the most to the global environmental damage too, because some of them have actually very successful waste manage systems and infrastructure. For instance, the countries with the highest mismanaged waste in 2010 were China, Indonesia, Philippines, Vietnam, Sri Lanka, etc. (Jambeck et al., 2015)
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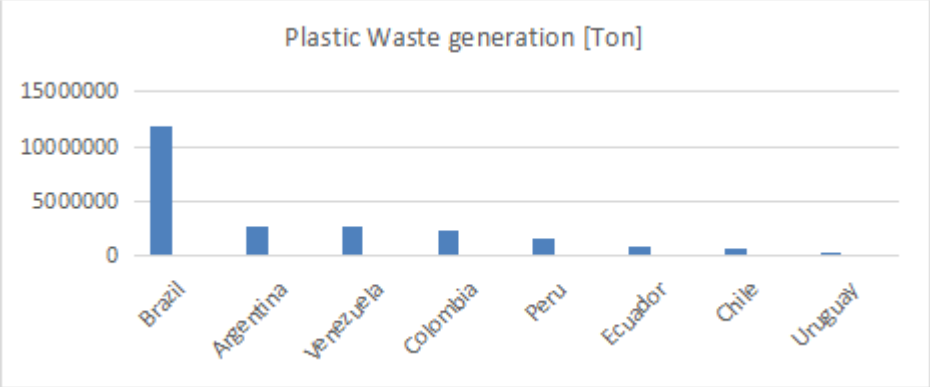
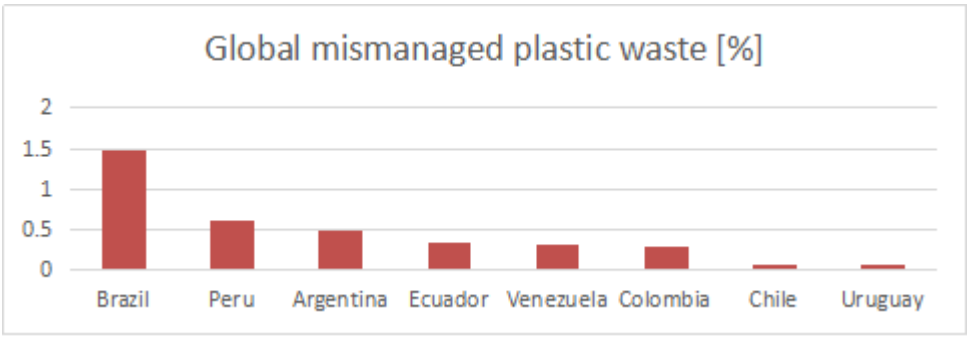
Chart 2: Plastic Waste generation in South America



Source: Jambeck et al., 2015

It is observed in chart 2 that Brazil, Argentina, Venezuela, Colombia and Peru are the main producers of plastic waste, but specially Brazil which represents 5 times the production of the second one (Jambeck et al., 2015).

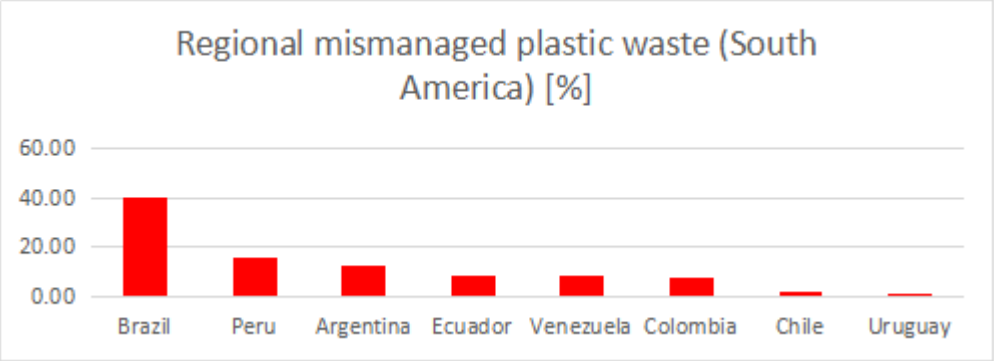
Chart 3: Global mismanaged plastic waste



Source: Jambeck et al., 2015

Chart 3 shows the plastic waste contribution in global terms, which in total of South American countries represent about the 3.8% of the global production (Jambeck et al., 2015). Even though Ecuador did not appear in the top five of countries which produce more plastic, it does appear in the top five of countries which more mismanaged this waste.

Chart 4: Regional mismanaged plastic waste (South America)



Source: Jambeck et al., 2015

According to chart 4, although Ecuador contributes with just the 0.3% of the global mismanaged plastic waste, within the region Ecuador contributes with the 10% of the total.

Chart 5: Mismanaged plastic waste per capita [kg/person/year]

Source: Jambeck et al., 2015

According to Chart 5, Brazil still is at the same position being the first plastic waste producer per capita in South America even its population is the highest in the continent. Moreover, Ecuador is in the sixth position with approximately 5kg of mismanaged plastic waste per capita every year.

According to a technical document titled Environmental Information Modulus at Homes written by authors of the Census and Statistical National Institute (INEC) approximately 48% of the Ecuadorian homes classify their waste. It means that 50% of the waste is disposed with the common waste, and the rest is discarded in a special container, used to make compost, is burned, or is sent to be reprocessed in a factory. Of the waste that is separated, approximately 30% is plastic (Benavides et al., 2017). After these introduction and background, the purpose of this study is to determine till which point these plastic waste historic data match with real data taken from a certain group of people, this is explained in detail in the following point.

From a legal approach, it can be said that Ecuador has a legal base that aims to reduce plastic generation, for instance the constitution says that it is imperative to foment bioplastic, research, technology and different forms to reduce plastic production (Tapia Núñez, 2014), but in real life this kind of premises are not effective. Indeed, according to (Servicio de Rentas Internas, 2020) there is a tax for the companies that produce non-returnable plastic bottles of 0.02 USD for every bottle, but this seems not to be enough to reduce the mismanaged waste. In the case of beverage industry, a likely and simple solution may be return to glass-returnable bottles as 40 or 50 years ago (ECOTEC, 2020), but this obviously mean an increment of the production cost for the companies which, in many cases, are not too open to make these changes in the production chain of their factories such as Coca Cola (DW Documental, 2019).

Methodology

The methodology imbedded in this investigation is quite simple. A sample of 51 students was used for 5 weeks. The students belong to the Transportation Management Department of ESPOCH. They were asked to separate and weight (1-gram precision) their daily waste in the following groups and fulfill a survey after every week from January the 6th till February the 2nd. The following list displays the types of waste that were classified.

- Polyethylene Terephthalate (PET): Commonly found in plastic bottles.
- High-Density Polyethylene (HDPE): Commonly found in plastic bags and bottle taps.
- Polyvinyl Chloride (PVC): Commonly found in plastic pipes and accessories.
- Low-Density Polyethylene (LDPE): Commonly found in plastic bags for food that require refrigeration.

- Polypropylene (PP): Commonly found in plastic bags for food like snacks.
- Polystyrene (PS): Commonly found in plastic tableware.
- Other plastics
- Paper
- Paperboard
- Metals
- Glass
- Organic
- And no recyclable: This includes sponges, porcelain, brooming dirt, cigarrete butts, and others.

Besides these data, the interviewed were asked with some personal information like name, residence, members at home, income.

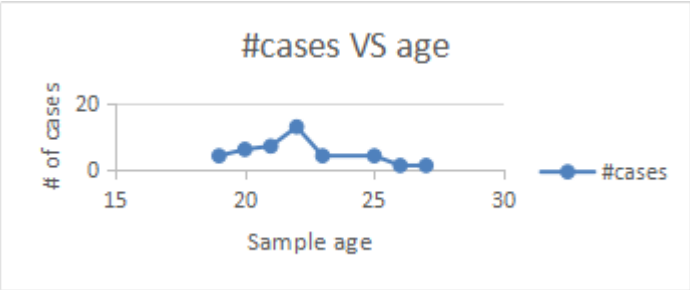
Once the data was collected, the data were processed by R free software, where, for instance extreme or pole data were discarded. An average production of every kind of waste were determined considering all the collecting data time period (5 weeks). There is presented cross-data relationships between findings, for instance, average waste production VS average income, average waste production VS residence place, or average waste production VS age.

Besides, from all the plastic information, it was collected information about the main supply companies to research about their inverse logistic plans aiming to reduce mismanaged plastic production in Ecuador.

Results and Discussion

Regarding the sample, this study analyses three conditions about the sample in order to analyze their relationship with the waste production at home. The first sample condition to be analyzed is its age, whose distribution can be found in **¡Error! No se encuentra el origen de la referencia.**, where it is clear that the age range (19-27 years old) is not so wide, so the age parameter is not going to be consider in this study. Nevertheless, it can be a start point for further researches.

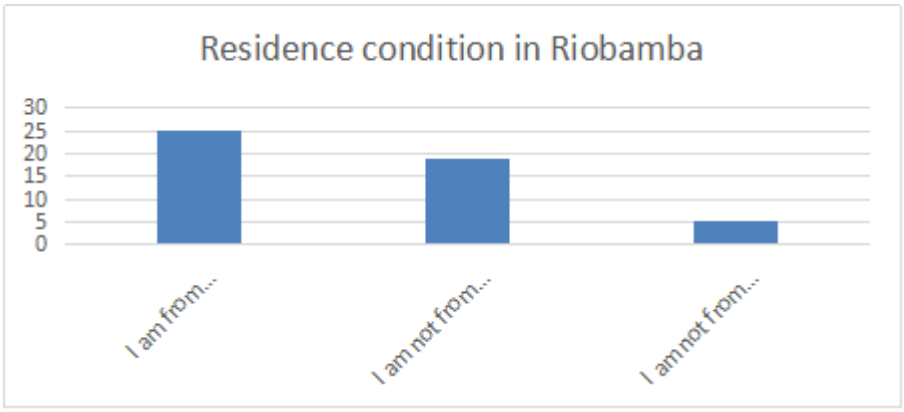
Chart 6: Sample age distribution



Source: Authors, 2020

The second sample condition to be analyzed is the sample residence condition which is displayed in where the highest number of people are from Riobamba, then the second place corresponds to the students that are not from Riobamba bur live there because of their studies (The most of them live alone), and finally there is the people who live in the towns or cities close to Riobamba and commute every day from and to this places for studies purposes. This parameter is going to be consider as a factor of change in the waste production in the following paragraphs.

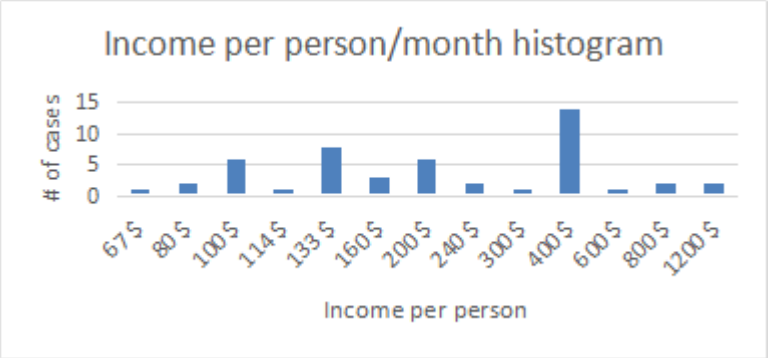
Chart 7: Sample Residence condition



Source: Authors, 2020

Finally, there is the income condition which is exposed in chart 7. This illustration indicates a huge variety of income. There is important to mention that this factor was calculated as a ratio of the income from the poll and the number of members per family. This characteristic is considered as variable of the waste production.

Chart 8: Income per person/month histogram



Source: Authors, 2020

In the following figure, it is displayed a small sample of the separated materials commonly used at home, like food, cleaning products, bags, etc.

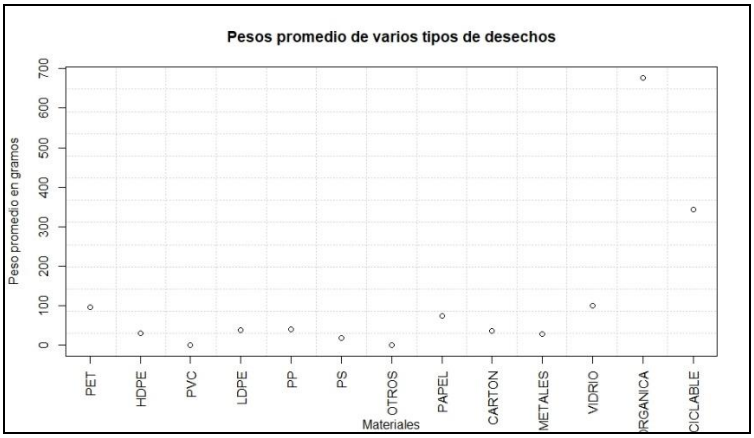
Figure 4: Collected waste figure gallery sample

		
PET	HDPE	LDPE
		
PP	PS	Paper and paperboard

		
	Tetrapack	

Source: Authors, 2020

Figure 5: Average weight of the collected waste



Source: Authors, 2020

Figure shows the average weight from every kind of collected waste, measured in grams per week, whose values are also shown in Table 1. The highest amounts of waste are Organic, Non-recyclable, glass, PET, and paper/paperboard.

Table 1: Average weight of the collected waste

Material	Average Waste weight/week/person [g]	Average Waste weight/year/person [g]	Average Waste weight/year/person [%]
PET	96	4623	6.48

HDPE	31	1494	2.09
PVC	0.91	44	0.06
LDPE	40	1904	2.67
PP	41	1944	2.72
PS	18	876	1.23
OTHER	1	48	0.07
PAPER	74	3543	4.96
PAPERBOARD	36	1724	2.42
METAL	29	1384	1.94
GLASS	100	4783	6.70
ORGANIC	677	32495	45.51
NO RECYCLABLE	344	16531	23.16
TOTAL	**1487**	**71393**	100

Source: Authors, 2020

Table 1 shows the average weight of waste per type of material in every week and year. It is important to mention that the year period was calculated by the product of the week mean times the number of weeks in a year (48).

Table 2: Average Produced Waste per year

City	**Province**	**Population (Urban Area)** (INEC, 2010)	**Average Produced Waste weight/year [Ton]**
Quito	Pichincha	1607734	114782
Guayaquil	Guayas	2278691	162684
Cuenca	Azuay	329928	23555
Santo Domingo de los Tsachilas	Santo Domingo	270875	19339
Riobamba	Chimborazo	146324	10447

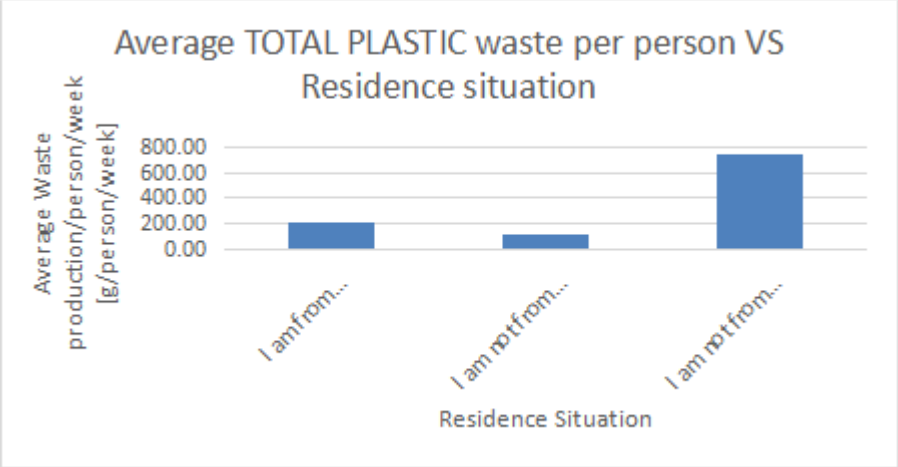
Source: Authors, 2020

According to Table 1, the total of waste produced every week is approximately 1.5kg per person. If this rate is considered for the main cities in Ecuador a huge amount of waste is produced every year from which according to (Benavides et al., 2017), about 50% is mismanaged. It is imperative to mention that yearly waste is just a slight approximation, because only home waste was

considered. Indeed, in Quito city every day 2200 to 2400 Tons is collected by the Public Metropolitan Enterprise of Cleanliness from Quito (EMASEO) (Nadia Carrera, 2018).

According to the residence parameter (Citizens from Riobamba, Residents in Riobamba for studies purposes, and students who commute every day to their hometowns outside Riobamba), the following figures describes the behavior of this conditions affecting the waste production.

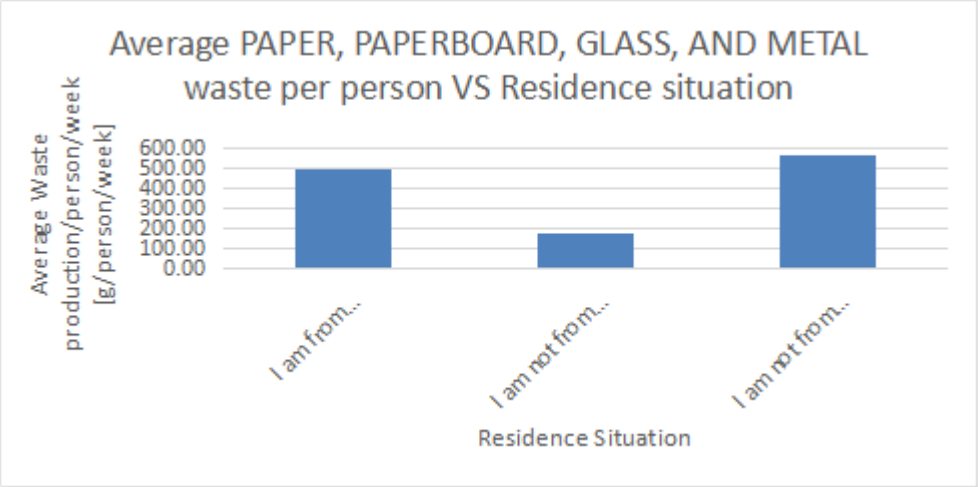
Chart 9: Average TOTAL PLASTIC waste per person VS Residence situation



Source: Authors, 2020

Chart 9 it is visible how people who live outside of Riobamba produce more plastic per person than other people groups, and students who live alone in Riobamba produces less plastic waste than other groups.

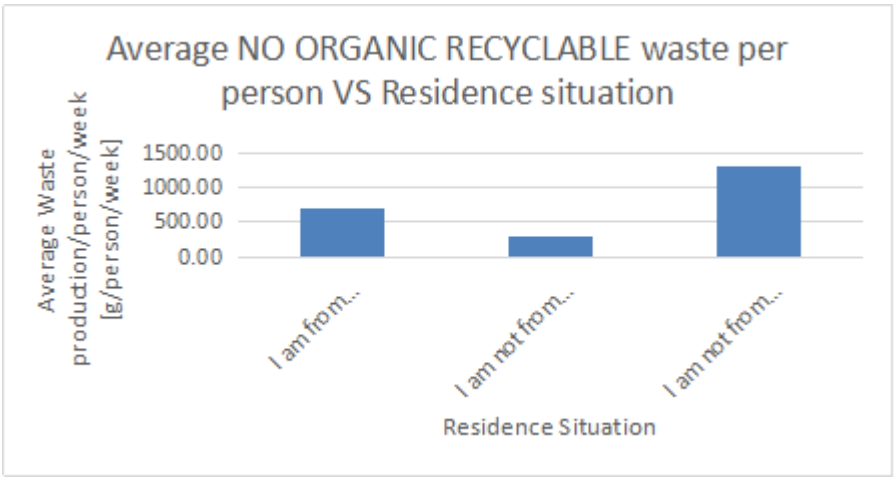
Chart 10: Average PAPER, PAPERBOARD, GLASS, AND METAL waste per person VS Residence situation



Source: Authors, 2020

Regarding paper, paperboard, glass, and metal, chart 10, explains how people from Riobamba and who live in closes towns close to this cities, produce the highest rate per person of this kind of waste.

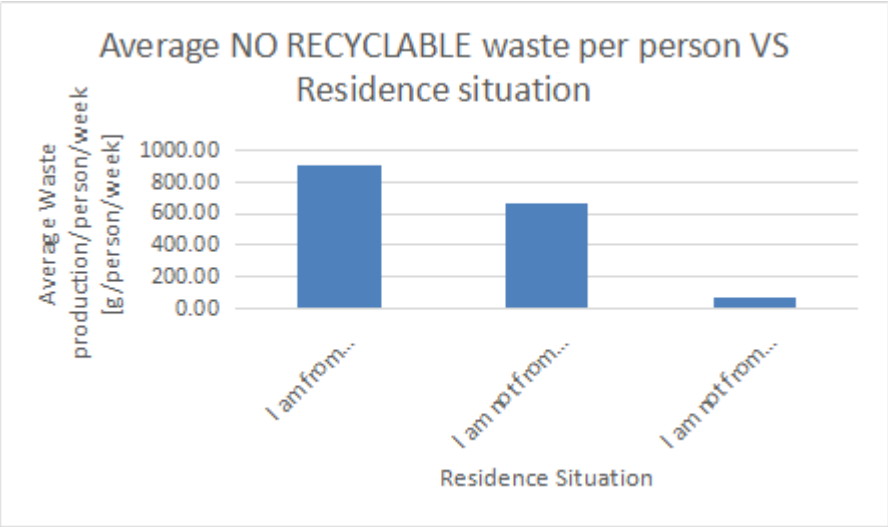
Chart 11: Average NO ORGANIC RECYCLABLE waste per person VS Residence situation



Source: Authors, 2020

Chart 11 shows how people who live in Riobamba due to studies proposes produces the lower amount of no-organic waste, like plastics, paper, glass, paperboard, and metal.

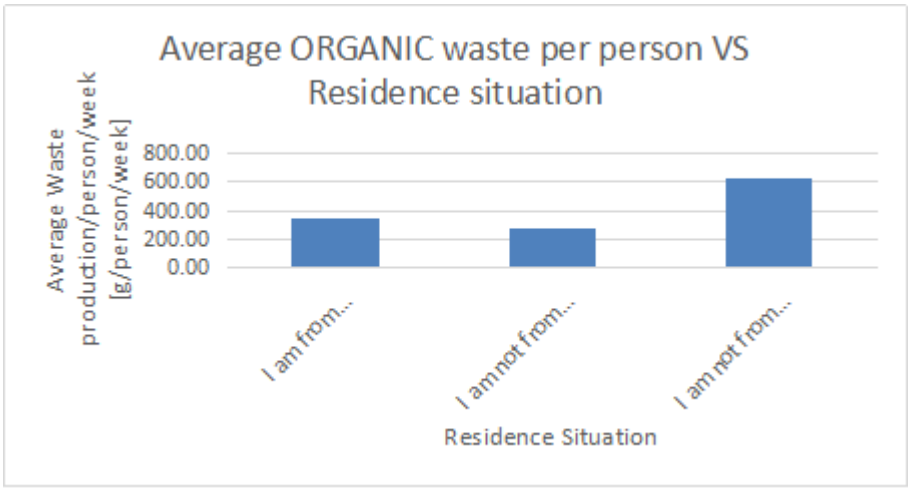
Chart 12: Average NO RECYCLABLE waste per person VS Residence situation



Source: Authors, 2020

Chart 12 illustrates how residents from Riobamba and students who reside there for studies, produces the highest amounts of waste comparing to the group left.

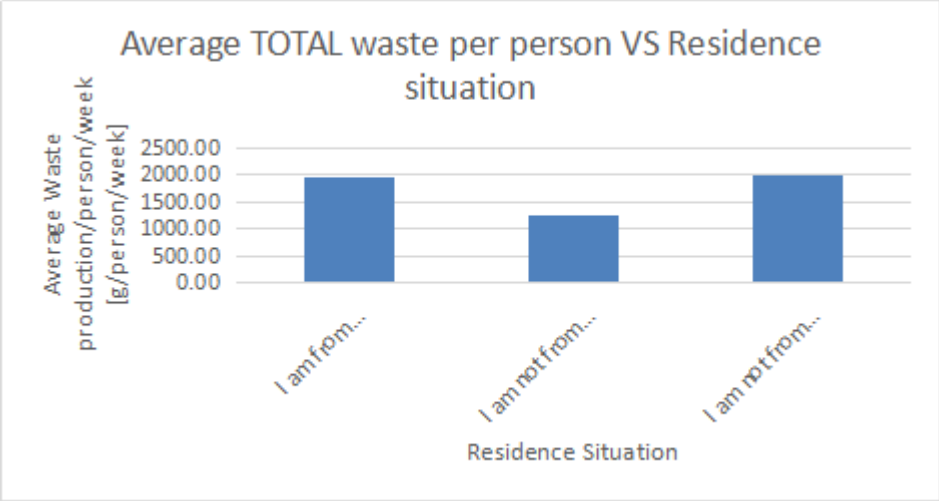
Chart 13: Average ORGANIC waste per person VS Residence situation



Source: Authors, 2020

In regards to **¡Error! No se encuentra el origen de la referencia.** the rate of organic waste per person from the Riobamba residents and people who resides due to studies' reasons are similar (300 g/week/person), and having a greater rate the people who live outside of Riobamba.

Chart 14: Average TOTAL waste per person VS Residence situation



Source: Authors, 2020

Chart 14 describes how in average the students whose residence is Riobamba due to their studies, is the group which produces the less amount of waste comparing permanent residents in Riobamba or other towns or cities around. It is imperative to notice that unfortunately the sample in the case of students who commute every day to nearby towns/cities is quite limited, so it is recommendable to consider this aspect for further studies.

According to the income parameter, meaning the amount of money that enters to a student's family divided by the members of it, the following figures can describe the behavior of this conditions affecting the waste production.

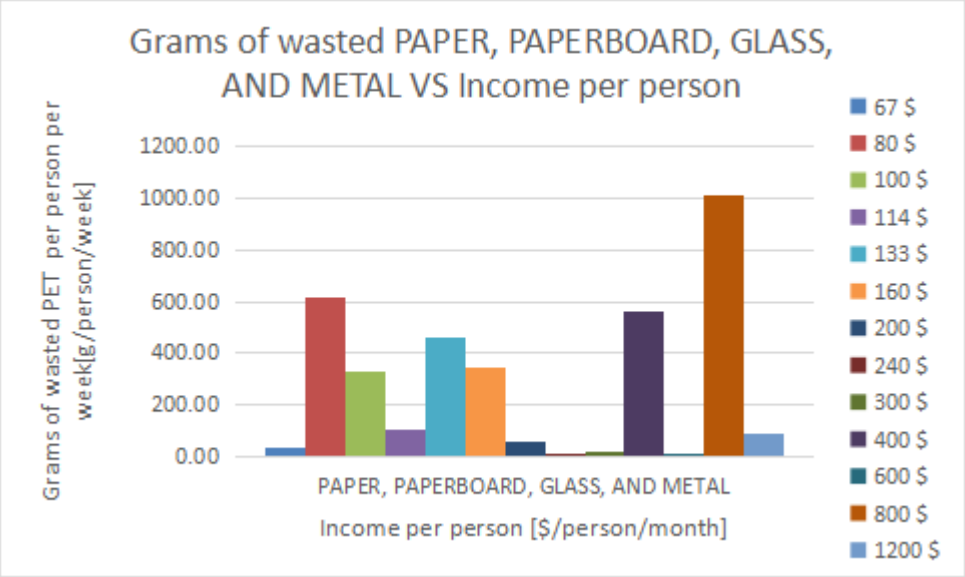
Table 3: Summary of waste production per material [grams] VS. Residence condition

	I am from Riobamba or practically I am established in this city.	**I am not from Riobamba, but I live here because of my studies.**	**I am not from Riobamba and I commute every day to city/town.**
PET	74.93	72.20	108.92
HDPE	47.55	7.63	36.99
PVC	0.40	1.81	7.70
LDPE	49.45	13.36	198.78
PP	38.32	15.93	49.28
PS	4.84	2.50	344.25
OTHER	1.94	0.85	0.36
TOTAL	217.44	114.28	746.27

PLASTIC			
PAPER	108.03	18.57	93.94
PAPERBOARD	35.88	27.85	361.01
METAL	28.72	17.85	45.40
GLASS	322.38	113.09	60.17
PAPER, PAPERBOARD, GLASS, AND METAL	495.00	177.35	560.52
NO ORGANIC RECYCLABLE	712.45	291.63	1306.79
NO RECYCLABLE	899.72	666.92	67.16
ORGANIC	350.18	281.70	629.49
TOTAL	1962.35	1240.25	2003.45

Source: Authors, 2020

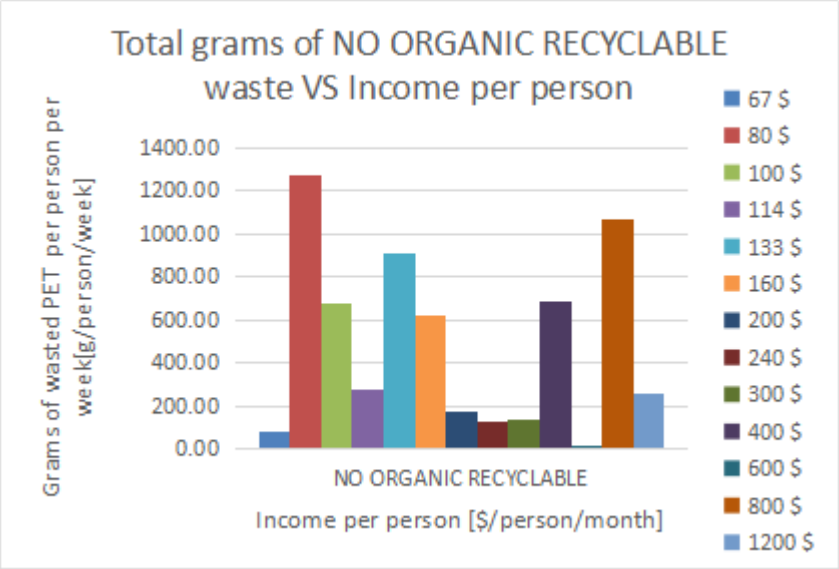
Chart 15: Grams of wasted PAPER, PAPERBOARD, GLASS, AND METAL VS Income per person



Source: Authors, 2020

Chart 15 reveals that the zone of the sample which produces more paper, paperboard, glass, and metal is that one with a relative high income per person. In this case, the group of people who theoretically can afford more products produce more waste.

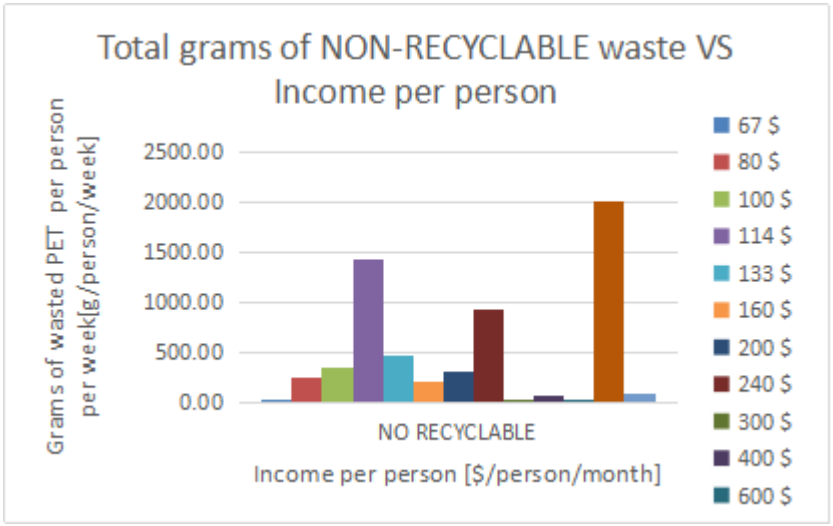
Chart 16: Total grams of NO ORGANIC RECYCLABLE waste VS Income per person



Source: Authors, 2020

Chart 16 shows an aggregated rate of waste per person, considering plastic, paper, paperboard, glass, and metal. According to this figure, there are two relative peaks, the first one with a low income, and the second one with a high income per person per month.

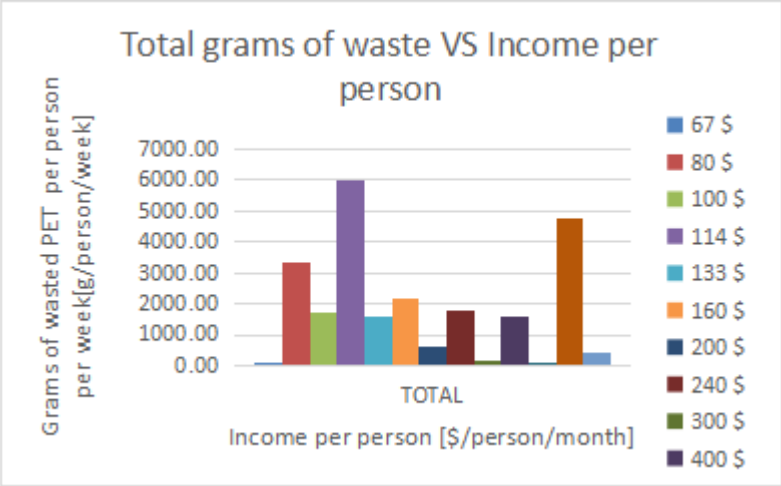
Chart 17: Total grams of NON-RECYCLABLE waste VS Income per person



Source: Authors, 2020

Chart 17 describes how highest income per person corresponds to the highest rate of non-recyclable waste production.

Chart 18: Total grams of waste VS Income per person



Source: Authors, 2020

Chart 18 shows the total waste production where the opportunity to stablish inverse logistics systems is clearly visible. In general terms the highest volume of waste is produced by people with low income even though it is assumed that they have less chance to buy products.

Conclusions and Recommendations

Waste is huge problem not only for Ecuador, but the whole world. Even though, there have been several agreements between countries to diminish waste and CO2 emissions, the rate still positive, which is a serious concern for the scientific and technical community. This study is focused on home wasted products which needed logistics to come to their final destination and whose contribution to the global waste production is 40% corresponding to packaging, including food, electronics, cleaning elements and other types. In Ecuador 50% from all the home waste is mismanaged and contributes negatively directly to the environment. Indeed, in Ecuador most cities does not count with a recycling system from the municipalities, for instance Riobamba, Quito, or Guayaquil.

The methodology used to seize the home waste consisted on a relative simple process, where every sample member were asked to separate their home waste every week in the following groups PET, HDPE, PVC, LDPE, PP, PS, OTHER PLASTICS, PAPER, PAPERBOARD,

METAL, GLASS, NO RECYCLABLE, and ORGANIC. Then every waste group were weight in an electronic scale and disposed to the common waste due to the fact that the city where the experiment was carried out does not have a recycling system. The findings showed that approximately a person produces 1.5kg of waste per week. This means a lot of waste for the environment and cost for the Municipality to manage these materials. It is imperative for the Municipality and factories to find ways to implement inverse logistics solutions in cities, otherwise in a few years these urban areas will collapse due to waste.

Regarding PET, almost all the collected waste was produced by drinks factories. Even though these companies have shown a relative important commitment with the environment, the situation does not seem positive. It would be useful to come back to glass returnable recipients although this represents higher production costs, but it looks fairer than filling the planet with plastics. Obviously, this kind of social reforms need new trend politics perspective, which this paper aims to help in.

Other materials which represented the highest amounts according to the findings are PP and LDPE because they represent packages many products, for instance: chocolates, snacks, cookies, cleaning products, supermarkets bags, and other. Unfortunately, almost 100% of the cities, factories, companies, and corporations in Ecuador do not have any system to reposition those materials in the production chain again.

It is important to mention the high amount of organic waste in the findings. This represents a huge opportunity to reprocess this waste producing compost or home gardening instead of ending as refill under the ground and implying high cost for Municipalities and the environment.

The importance of this study is motivating new research which can take the observations and recommendations derived from this document. For instance, it would be important to consider the companies that gain more revenue and evaluate their inverse logistics programs. Besides, it would be imperative to modify the sample, and make it at regional or national level, differentiating urban and rural areas which have different behavior.

Referencias

1. Benavides, R., Guallasamin, K., Pilataxi, C., Murgueitio, M. J. y Naranjo, L. (2017). Módulo de Información Ambiental en Hogares.

2. Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Úbeda, B., Hernández-León, S., Palma, Á. T., Navarro, S., García-de-Lomas, J., Ruiz, A., Fernández-de-Puelles, M. L., y Duarte, C. M. (2014). Residuos plásticos en mar abierto. Actas de la Academia Nacional de Ciencias de los Estados Unidos de América, 111 (28), 10239-10244. https://doi.org/10.1073/pnas.1314705111
3. DW Documental. (2019) Coca Cola y un mundo lleno de basura DW Documental - YouTube. https://www.youtube.com/watch?v=EingNA5cdYA
4. ECOTEC. (2020). Estudio sobre impuestos y cargas medioambientales en la UE.
5. Elias, S. (2018). Plásticos en el océano. En Módulo de Referencia en Sistemas de la Tierra y Ciencias del Medio Ambiente. Elsevier https://doi.org/10.1016/b978-0-12-409548-9.10514-7
6. Geyer, R., Jambeck, J. R., y Law, K. L. (2017). Producción, uso y destino de todos los plásticos jamás fabricados. Avances científicos, 3 (7), e1700782. https://doi.org/10.1126/sciadv.1700782
7. Iberdrola. (2020). Isla de plástico en el Océano Pacífico, el Séptimo Continente - Iberdrola. https://www.iberdrola.com/environment/plastic-island-in-pacific-eighth-continent
8. INEC, I. E. de E. y C. (2010). Información Censal. https://www.ecuadorencifras.gob.ec/informacion-censal-cantonal/
9. Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R. y Law, K. L. (2015). Residuos plásticos de la tierra al océano. Science, 347 (6223), 768–771. https://doi.org/10.1126/science.1260352
10. Nadia Carrera. (2018) EMASEO: ENTRE 2200 Y 2400 TONELADAS DE RESIDUOS SE RECOLECTAN DIARIAMENTE EN QUITO - Emaseo EP. http://www.emaseo.gob.ec/emaseo-entre-2200-y-2400-toneladas-de-residuos-se-recolectan-diariamente-en-quito/
11. Servicio de Rentas Internas. (2020). Impuesto Redimible Botellas Plásticas no Retornables - Servicio de Rentas Internas del Ecuador. https://www.sri.gob.ec/web/guest/impuesto-redimible-botellas-plasticas-no-retornables
12. Snowden, S. (2019). El nado de 300 millas a través del gran parche de basura del Pacífico recopilará datos sobre la contaminación plástica. https://www.forbes.com/sites/scottsnowden/2019/05/30/300-mile-swim-through-the-great-pacific-garbage-patch-will-collect-data-on-plastic-pollution/#20674d0f489f

13. Tapia Núñez, L. (2014). POLITICAS PARA GESTION INTEGRAL DE PLASTICOS EN EL ECUADOR. www.lexis.com.ec

References

1. Benavides, R., Guallasamin, K., Pilataxi, C., Murgueitio, M. J., & Naranjo, L. (2017). Household Environmental Information Module.
2. Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Úbeda, B., Hernández-León, S., Palma, Á. T., Navarro, S., García-de-Lomas, J., Ruiz, A., Fernández-de-Puelles, M. L., & Duarte, C. M. (2014). Plastic debris in the open ocean. Proceedings of the National Academy of Sciences of the United States of America, 111 (28), 10239–10244. https://doi.org/10.1073/pnas.1314705111
3. DW Documentary. (2019). Coca Cola and a world full of garbage DW Documentary - YouTube. https://www.youtube.com/watch?v=EingNA5cdYA
4. ECOTEC. (2020). Study on Environmental Taxes and Charges in the EU.
5. Elias, S. (2018). Plastics in the Ocean. In Reference Module in Earth Systems and Environmental Sciences. Elsevier. https://doi.org/10.1016/b978-0-12-409548-9.10514-7
6. Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science Advances, 3 (7), e1700782. https://doi.org/10.1126/sciadv.1700782
7. Iberdrola. (2020). Plastic Island in the Pacific Ocean, the Seventh Continent - Iberdrola. https://www.iberdrola.com/environment/plastic-island-in-pacific-eighth-continent
8. INEC, I. E. de E. and C. (2010). Census Information. https://www.eficienterencifras.gob.ec/informacion-censal-cantonal/
9. Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347 (6223), 768–771. https://doi.org/10.1126/science.1260352
10. Nadia Carrera. (2018). EMASEO: BETWEEN 2200 AND 2400 TONS OF WASTE ARE COLLECTED DAILY IN QUITO - Emaseo EP. http://www.emaseo.gob.ec/emaseo-entre-2200-y-2400-toneladas-de-residuos-se-recolectan-diariamente-en-quito/
11. Internal rents service. (2020). Reimbursable Tax Plastic Bottles Not Returnable - Internal Revenue Service of Ecuador. https://www.sri.gob.ec/web/guest/impuesto-redimible-botellas-plasticas-no-retornanables

12. Snowden, S. (2019). 300-Mile Swim Through The Great Pacific Garbage Patch Will Collect Data On Plastic Pollution. https://www.forbes.com/sites/scottsnowden/2019/05/30/300-mile-swim-through-the-great-pacific-garbage-patch-will-collect-data-on-plastic-pollution/#20674d0f489f
13. Tapia Núñez, L. (2014). POLICIES FOR INTEGRAL MANAGEMENT OF PLASTICS IN ECUADOR. www.lexis.com.ec

Referências

1. Benavides, R., Guallasamin, K., Pilataxi, C., Murgueitio, M.J. & Naranjo, L. (2017). Módulo de Informação Ambiental Doméstica.
2. Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Úbeda, B., Hernández-León, S., Palma, Á. T., Navarro, S., García-de-Lomas, J., Ruiz, A., Fernández-de-Puelles, M.L. & Duarte, C.M. (2014). Restos de plástico em mar aberto. Anais da Academia Nacional de Ciências dos Estados Unidos da América, 111 (28), 10239-10244. https://doi.org/10.1073/pnas.1314705111
3. Documentário da DW. (2019). Coca Cola e um mundo cheio de lixo DW Documentary - YouTube. https://www.youtube.com/watch?v=EingNA5cdYA
4. ECOTEC. (2020). Estudo sobre impostos e taxas ambientais na UE.
5. Elias, S. (2018). Plásticos no oceano. No Módulo de Referência em Sistemas Terrestres e Ciências Ambientais. Elsevier. https://doi.org/10.1016/b978-0-12-409548-9.10514-7
6. Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Produção, uso e destino de todos os plásticos já fabricados. Science Advances, 3 (7), e1700782. https://doi.org/10.1126/sciadv.1700782
7. Iberdrola. (2020). Ilha plástica no Oceano Pacífico, sétimo continente - Iberdrola. https://www.iberdrola.com/environment/plastic-island-in-pacific-eighth-continent
8. INEC, I. E. de E. e C. (2010). Informações do Censo. https://www.eficienterencifras.gob.ec/informacion-censal-cantonal/
9. Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., & Law, K.L. (2015). Insumos de resíduos plásticos da terra para o oceano. Science, 347 (6223), 768-771. https://doi.org/10.1126/science.1260352

10. Nadia Carrera. (2018). EMASEO: ENTRE 2200 E 2400 TONELADAS DE RESÍDUOS SÃO RECOLHIDOS DIARIAMENTE NO QUITO - Emaseo EP. http://www.emaseo.gob.ec/emaseo-entre-2200-y-2400-toneladas-de-residuos-se-recolectan-diariamente-en-quito/
11. Serviço de aluguel interno. (2020). Garrafas plásticas de impostos reembolsáveis não retornáveis - Receita Federal do Equador. https://www.sri.gob.ec/web/guest/impuesto-redimible-botellas-plasticas-no-retornanables
12. Snowden, S. (2019). Um mergulho de 300 milhas através do Great Pacific Garbage Patch coletará dados sobre a poluição plástica. https://www.forbes.com/sites/scottsnowden/2019/05/30/300-mile-swim-through-the-great-pacific-garbage-patch-will-collect-data-on-plastic-pollution/#20674d0f489f
13. Tapia Núñez, L. (2014). POLÍTICAS DE GESTÃO INTEGRAL DE PLÁSTICOS NO EQUADOR. www.lexis.com.ec