

Waste Management in Residential Units "Analysis of the Minuto de Dios neighbourhood. Bogotá, Colombia"

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ABSTRACT

Economic development continues to be driven by various forms of consumption, causing the exponential generation of waste largely from households whose inadequate management also affects the work of the informal waste picker. Thus, this study analyses the case of the town of Engativá in the city of Bogotá where there is serious concern about waste management. A sample of 10 residential units in the Minuto de Dios neighbourhood was considered in order to analyse the management, separation, classification and disposal of household waste, the incentives that the residential units have to implement and strengthen waste management, and the consequences that these behaviours have on the informal waste picker. This research was approached from a qualitative approach with the identification and characterisation of residential units located in the area under study. The results were obtained by conducting interviews with managers of the residential units. The main findings include a low percentage of units with a waste management plan, partly because they do not know how to implement it or do not have adequate resources and infrastructure. There is great concern about the low culture and awareness of residents in waste management and the marked indifference towards waste pickers that marginalises their activity. This study highlights the importance of addressing cultural and social reasons that continue to limit adequate waste disposal, deepening the scope of public policies on waste management and implementing strategies that create trust between residents, managers and waste pickers so that the latter have the opportunity to dignify their work through recognition and support from households in adequate waste separation.

Keywords: Solid waste management, residential units, household waste, informal recycler.

RESUMEN

El desarrollo económico sigue estando impulsado por diversas formas de consumo, causando la generación exponencial de residuos provenientes en gran medida de hogares cuyo inadecuado manejo afecta también la labor del reciclador informal. Así, el presente estudio analiza el caso de la localidad de Engativá en la ciudad de Bogotá donde existe una seria preocupación en el manejo de residuos. Se tuvo en cuenta una muestra de 10 unidades residenciales en el barrio Minuto de Dios, con el fin de analizar el manejo, separación, clasificación y disposición de residuos domiciliarios, los incentivos que tienen las unidades residenciales para implementar y fortalecer la gestión de residuos y las consecuencias que estos comportamientos tienen para el reciclador informal. Esta investigación se abordó desde un enfoque cualitativo con la identificación y caracterización de unidades residenciales localizadas en la zona objeto de estudio y los resultados obtenidos proceden de la realización de entrevistas a administradores de los conjuntos residenciales. Dentro de los principales hallazgos se evidencia un bajo porcentaje de unidades con plan de manejo de residuos, en parte porque no tienen conocimiento de cómo implementarlo o no cuentan con recursos e infraestructura adecuada. Existe gran preocupación frente a la poca cultura y conciencia de los residentes en el manejo de basuras y la marcada indiferencia con recicladores de oficio que margina su actividad. Este estudio deja en evidencia la importancia de abordar razones culturales y sociales que

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siguen limitando la adecuada disposición de residuos, profundizar en el alcance de políticas públicas de gestión de residuos y la implementación de estrategias que permitan crear lazos de confianza entre residentes, administradores y recicladores para que estos últimos tengan la oportunidad de dignificar su labor a partir del reconocimiento y apoyo por parte de los hogares en la adecuada separación de residuos.

Palabras claves: Manejo de residuos sólidos, unidades residenciales, residuos domiciliarios, reciclador informal.

1. Introduction

The treatment of domestic solid waste, also called urban solid waste, has harmed the environment worldwide as a result of its inadequate management since its final disposal has caused specific damage to ecosystems and environments closest to human beings.

Solid waste management is an issue that several authors have addressed, since, undoubtedly, as stated (Razali, Daud, wai, Ranga & Jiram, 2020) in their analysis of waste separation at the source of Malaysian households, these practices become the fundamental basis for the inclusion of materials in the flow of the circular economy from generation, separation at source and disposal to make this process happen.

Given its importance, one of the policy strategies has been solid waste management. As stated by Aleluia & Ferrão (2016), the institutional framework of countries should include environmental policies that promote the management of such waste. Thus, in Colombia, the Political Constitution of 1991 establishes the protection of the environment and the right of the

community to enjoy a healthy environment. Several normative sections relate to the scheme of use, and that also speaks about the integral management of waste, as well as the waste generated and collected (Congreso, 1991).

In 2019, the Bogotá Council revealed that the Colombian capital could generate nearly 6,300 tons of waste daily, materials that should be served by the waste collection systems set up by the Mayor's Office. According to this same study, only 14% of these tons of waste are recovered (Suárez Bedoya & C.B., 2019) and used through practices such as recycling, with which more than 5,400 tons of waste end up in the sanitary landfills on the outskirts of the city. At "Doña Juana", Bogotá's main sanitary landfill, it is estimated that up to 265 million USD can be buried annually in waste such as paper, cardboard, glass, plastic and most metals of different kinds that could have been reused. Today it is estimated that the "useful life" of the landfill will end in 2022 and for this reason, it is essential to increase the recovery of materials, not only with the ambition of a possible economic benefit but also for a more favorable

environmental impact (Herazo & Montaña, 2018).

Now, understanding the context of solid waste management in Bogotá that shows the importance and good management that should be taken with them, in terms of separation and disposal, the Secretariat of Habitat (2018) presents in the baseline for the Plan for Integrated Solid Waste Management (PGIRS)⁴ of Bogotá, the critical points in the urban area that are in different locations.

The borough of Engativá, one of the largest in Bogotá and the third most densely populated, has the third-largest number of critical points for solid waste management, specifically 59. It is worth mentioning that in the bibliographic review carried out, no studies different from the one mentioned were found, which show an analysis of the dynamics of the residents of the Engativá locality in the attention to the inadequate management of domestic solid waste.

Therefore, and within the framework of the Alianza EFI⁵ project, the present investigation seeks to deepen the behaviour of the households that live in closed residential units (RU) concerning the management of domestic waste derived from

their daily consumption practices and how this interferes with the work of the official recycler.

Taking into account the social and economic structure of the *Minuto de Dios* neighbourhood in Engativá, the behaviour of a series of RU adjacent to the *Minuto de Dios* University (UNIMINUTO) was analyzed, taking advantage of the proximity between them. The neighbourhood is taken as a fundamental reference for its social project, in the transcendence of more than 50 years, which still retains strategies such as "social practice" (Hurtado, 2011), which were essential to analyze the strategies carried out with the waste generated and to propose new models replicable in the locality.

It is important to mention that the *Minuto de Dios* neighbourhood has consolidated itself as one of the most important in the locality, with an expansion of 373 hectares (Multipurpose Survey of Bogotá, 2017), and an urban design made up of 21 RU that contemplate a total of 2852 homes, 1300 of them single-family and 1552 of a multi-family nature (Data of interest - Portal

⁴ PGIRS: It is the instrument of municipal or regional planning for the management of solid waste, based on the policy of integral management of the same ones, it is contemplated in the Decree 1077 of 2015 (*Portal Minvivienda Planes de Gestión Integral de Residuos Sólidos PGIRS*, n.d.)

⁵This project is a consorcium of universities and social organisations and it funded my the Colombian Ministry of Sciences under the grant Colombia Científica call. The formal name of the project is: Productive and Social Inclusion: Programs and Policies for the Promotion of a Formal Economy (Alianza EFI, 2020).

UNIMINUTO, n.d.), fundamental characteristics for the research.

Besides, this study seeks to characterize the capacities of the residential complexes, the spaces available for recovery, the connection with the sanitation systems and with waste pickers, among other variables that seek to study in a "micro" but detailed way. We also consider the behaviour of the residents about waste disposal, because as it is indicated (Villalba, L., 2020) the analysis of the waste flow generated by a community, establish solid bases for the evaluation of the recovery and safe disposal of materials; with this not only the current diagnosis is assured, but also future research in favour of improvement strategies.

However, recycling has a very important role for waste management, also, because it allows the classification and use of materials, as well as cushioning the negative effects that bring bad cultural practices in terms of the relationship of communities with their waste and environmental conservation, too; it achieves savings for the public sector by extending the life of landfills while providing the industrial sector with raw materials and reducing the level of greenhouse gas emissions (Burneo et al., 2020).

2. Description of the activity

2.1. Methodology

We analyze primary quantitative and qualitative data collected at the Minuto de Dios neighbourhood using a random survey of 10 of the 25 RU. This information was obtained as part of the Alianza EFI project, which covers several aspects of circular economy. Finally, we perform a qualitative analysis of the interviews.

This study allowed a descriptive analysis since it details situations, specifics, important properties of individuals, groups, communities or any other phenomenon that is subject to analysis (Sampieri, 2014).

Thus, the study in mention reviews the behaviours of some of the RU of the *Minuto de Dios* neighbourhood, in front of the dynamics of separation, classification and disposition of solid remainders on the part of the residents being approached from a qualitative analysis product of the results of the interviews made to ten representative RU.

The data was collected through intervention in RU, where initially the area under study was defined under the consideration of external scenarios such as the university, schools, a wetland, among other factors that showed that it corresponded to a strategic place for the assessment of the dynamics of its inhabitants. The geographical space selected is presented in Figure N°1, where the neighbourhood is related, graphically describing

the three residential areas under study. It is worth mentioning that these areas were divided by the geographical distribution in which they were located.



Figure 1. Illustration of geographic segment under study, extracted from Google maps.

Later, the RU that were in the zone object of study were identified and a universe of 25 was defined. This selection was carried out in a random way, with the aim of achieving that the sample was not concentrated in a single zone. This allowed the selection of residential sets or apartments of the neighborhoods Minuto de Dios and some adjacent of the neighborhood La Serena with the purpose of identifying homogeneous characteristics like, for example, that they will count on an administration so that they were who finally gave answer. Thus, a sample of 10 RU was defined taking into account the characteristics mentioned above, the effectiveness in contact and the willingness of the administrators to participate in the research.

Supporting the collection of information on behalf of Minuto de Dios University and the provision of informed consent generated bonds of trust with the interviewees, to protect personal data and ensure that the collaboration was voluntary, as well as to state the academic purposes for which it would be used.

The instrument that was designed was an interview that contained 20 guided questions, which were validated with the technical team of the Alianza EFI and were aimed at exploring first-hand information with the administrators assuming that they are the main experts on the dynamics of solid waste management in the RU.

This interview was divided into three segments: the first sought to collect basic data on the RU, the second related to the treatment, management and disposal of solid waste within the sets, and the third identified the communication channels that the administration had with the various actors (residents and waste pickers by trade) and which were so effective in relating to the promotion of waste management plans.

The analysis of the data uses the basic statistics for the relationship of the variables that will be presented according to the three segments. The stages in which this research was developed are mentioned below:

- **Phase N°1: Characterization of the samples**

The first phase was carried out through the digital platform Google Maps, which allowed to georeference the RU and to access the vast majority of locations, where a field exploration was carried out to obtain telephones and contacts for the interviews. Thus, with telephone communication and a visit in person, appointments were scheduled for the application of the instrument, taking into account the prior completion of the "informed consent".

- **Phase N°2: Application of the instrument**

In this phase, the instrument was applied to RU administrators. In this data collection, at the same time that managers were counting much of the information, they were also unaware of relevant data. However, thanks to their collaboration it was possible to talk to employees and some waste pickers who served in the clusters, which enriched the information and increased the contacts of the research group.

It is important to mention some aspects that delayed obtaining information such as the postponement of appointments of some administrators when they were contacted and the reluctance to provide information.

3. Data review

From the methodological perspective, the application of the instrument through which the "phenomena" related to solid waste recovery practices are recognized is established. Figure 1 below shows the way in which the results of the RU that were taken into account for the sample were conceived:

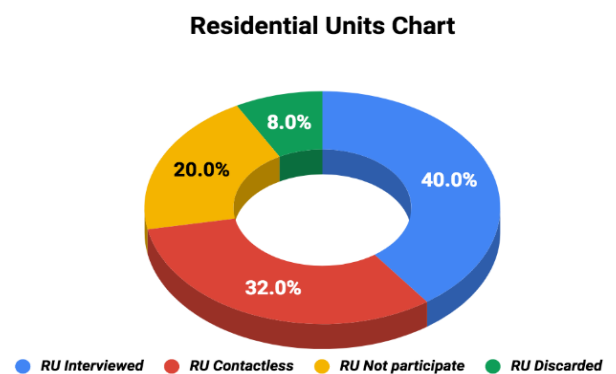


Figure 2. Distribution of the RU universe. Own elaboration.

In the previous figure, the distribution of the initial universe is shown, which allows us to give structure to the sample in the following way: 32% of the RU after the telephone and/or face-to-face contact did not answer, so it was not possible to interview them. Twenty per cent were not willing to collaborate when considering the requested information as "sensitive"; in these places some fear was evidenced because it was thought that the information could be used for auditing purposes.

Eight per cent were not taken into account due to the lack and limitation of relevant information recorded in the instrument, which

was due to a certain mistrust with the researcher from the beginning of the interviews, which made it difficult for the information to be complete and accurate. Based on the above, we finally worked with 40% of the total universe, which for this research will correspond to 100% of the sample.

4. Results and discussion

The following is a list of the distribution of actors who participated in the interview process:

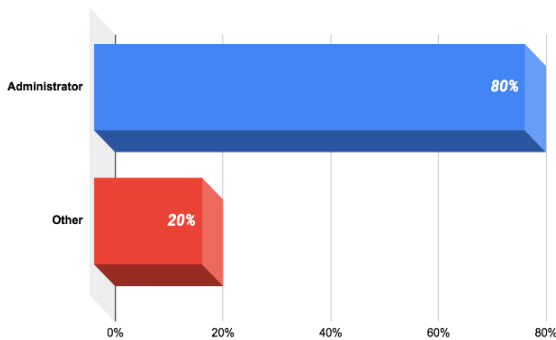


Figure 3. Position of the interviewer Own elaboration.

As it is evident, 80% of the people who were interviewed corresponded to the RU administrators, group of greater interest due to their knowledge and responsibility on the plans that are carried out within the RU, and the remaining 20% corresponded to the secretariats denominated as "others".

Within the socio-economic categories, it is important to mention the strata of the RU interviewed. In the neighbourhood these are divided in two: stratum 2 and 3 that are part of about

70% of the category of intermediate socioeconomic strata of the total Colombian population (Hernández-Berriel, Aguilar-Virgen, Taboada-González, Lima-Morra, Eljaiek-Urzola, Márquez-Benavides & Buenrostro-Delgado, 2017). Given the amount of RU of the zone, other residences that participated in the research were looked for in neighboring districts, so some RU of the districts Santa María del Lago and Parque de los Lagartos were added, this last zone of stratum 4.

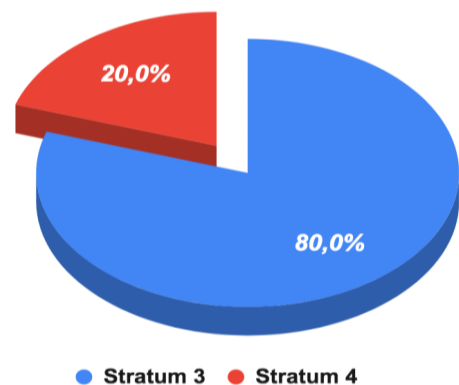


Figure 4. Graph of RU socioeconomic strata. Own elaboration.

It is important to emphasize as Alejandro, a recycler of office of the zone, mentions it, that although there is greater generation of remainders in the high strata, they are the low strata who more and better classify them which is related to the results of the present study when evaluating the delay in the processes of classification and management of remainders of the analyzed RU.

As opposed to the processes of waste management within the RU, 40% say that they do not have a Waste Management Plan for PRM⁶ and 10% of this 40%, in addition to not having a PRM, keep the waste containers in inadequate places for disposal within the set without evidence of any control or supervision against it. It is even worth mentioning that the day of the interview, a resident addressed the administrator to express his concern regarding the issue of waste management.

These results show concern since the bad management of domestic waste derived from the absence of PRM tends to be a common difficulty at the national level, which undoubtedly hinders the improvement in the recycling chain since it is imperative to consider the implementation of PRM within RU as a mandatory policy (Avendaño & Barrera, 2017).

It is evident that the administrations of at least 30% of RU have left the management of waste in the hands of the residents; there is great independence on the part of the resident concerning its management, for which reason it becomes complex for the administrations to generate control over the disposal of the waste in the interior (Velez Quintero, C.F., 2016).

It is generally established that separation at the source and subsequent disposal in waste rooms

are the only "techniques" considered to be PRM, processes that are complemented by the activity of waste pickers who offer their services in these RU. It is important to highlight that inadequate and poorly directed processes for the disposal and separation of domestic waste segregate leachates that lead to negative impacts (Mishra et al., 2019), directly affecting the human health of residents, and also because these substances are the focus of vectors such as rodents and/or insects that are attracted to poorly managed waste and residues (Mishra, Tiwary, Ohri, Agnihotri & Ashwani, 2019).

Adequate waste management in the RU creates opportunities to eradicate the disadvantages of poor waste disposal within households and residential complexes. Therefore, at the household level, different forms of waste management depend not only on personal disposal but also on the available space, time and financial situation of the household resources (Jouhara, Czajczyńska, Ghazal, Krzyżyńska, Anguilano, Reynolds & Spencer, 2017).

In fact, in one of the RU interviewed it was possible to speak with the waste picker, who expressed his concern and dissatisfaction with the waste management by residents and his weak

⁶ PRM: a set of measures adopted to prevent, minimize, separate, store, transport, use, recover, treat and dispose of

hazardous, non-hazardous and special solid waste in an appropriate manner to prevent or reduce the risk.

relationship with the administrations. He indicated that the waste disposal was not the best and the garbage rooms were becoming dirty and messy. To select the recoverable material, it was necessary to clean, order and prepare the garbage, as well as to do the respective maintenance of the place, to consolidate the material in better conditions.

On the other hand, 60% of the RU showed a high degree of interest on the part of the administrations to have better disposal of solid waste, which is evident in the waste rooms.

In these RU, it is considered that separation not only in homes but also in the garbage rooms should fall directly on the residents, i.e., a double responsibility is given in waste management. Besides, the administrations manifest the low culture of the residents and argue that, without concerning the classifications in the garbage rooms, these mix the waste affecting the order and contaminating the materials that had a suitable disposition and separation, the reason why for the administrators it is fundamental to strengthen the culture and conscience of the residents as the main pillar for the improvement in the waste management.

⁷ UAESP: Special Administrative Unit for Public Services whose purpose is to guarantee the coordination, supervision and control of the services of collection, transport, final disposal, recycling and use of solid waste, and the cleaning

As stated by (Han, Liu, Zhong, Shi, Li, Zeng, Zhang, Fei & Xie, 2018) in their approach to improving culture, some potential social factors impact on the low management of waste, which mainly lies in the lack of a culture of the population, as well as training and environmental education; as these factors can improve the awareness and habits of people by significantly improving the management of household waste.

In the RU where separation in the waste room and the implementation of a PRM based on the culture of the residents had already been attempted, since the expected results were not obtained, other measures were applied to cover these areas.

On the other hand, the 20% of RU where the administrators had a vast experience in horizontal property, it was considered key for the PMR to consider elements that in other RU were not taken into account such as the active integration of areas of culture, economic benefits, communication and support with state entities such as the UAESP⁷ in Colombia.

For example, 10% of RU had managed to acquire through the multi-user tariff⁸ a

of roads and public areas. (Secretariat of Habitat, n.d.)

⁸ The Multi-User Tariff is a request that can be made by owners of properties that are grouped into real estate units, plants residential complexes, condominiums or

discount on the toilet company's charge. It was found that the amount of waste being recovered was greater and therefore the waste collectors were collecting fewer and fewer tonnes of usable waste. Also, they claimed to have made an investment in the adaptation of the waste areas and to carry out training with waste picker associations so that residents could improve the sorting and disposal of waste at home and in the waste room.

Only 12% of the RUs had a structured plan with clear and achievable objectives through the strategies being implemented. The desire of some RU to establish a plan that would allow them to give waste better management was evidenced; it was estimated that in practically all the RU belonging to the 40% that assured they did not have any management plan, they would like to implement it when they expressed comments such as: "We are working to consolidate a plan" or "We do not know how to do it and we would like you to help us create one". The interest in improving this problem could be considered tacit in the role of each manager.

Although different forms and processes of treatment were found for the waste, the signalling and demarcation of the areas arranged are contemplated by 90% of UR. The waste rooms are generally divided into two parts: recyclable and

non-recyclable waste and, in other UR, up to three and four divisions were found to classify more specifically the materials by types such as glass, paper, cardboard and organic waste.

The demarcation of zones can be considered as the most used practice in the RU of the Minuto de Dios neighbourhood and its surroundings, it is subject to the article 111 of the police code (law 1801 of 2016). However, this practice does not carry the greatest weight in waste management. The administrations of the RU have used various methods to raise awareness among residents through some practices mentioned below, to separate their waste before disposing of it in the rooms that are intended for that purpose. This mechanism is generally present in all the RU interviewed. Even so, strengthening residents' cultural practices is still considered the best strategy for making PRMs work properly, as it translates into benefits for all those who benefit from the use of the material, especially the waste pickers.

Undoubtedly, increasing awareness and participation is of vital importance to empower residents in the traceability of PRM, successfully achieving functionality and interaction of the whole community over time,

similar under the current horizontal property or concentrated in shopping centres or similar, with the aim of

reducing costs in invoicing according to the volume of solid waste generated- (Bogotá Mayor's Office, 2020)

to ensure sustainability of the schemes (Yang, Li, Man, Peng, Zhang & Luo, 2019).

Within the strategies that are established, it is also important to take into account that the majority of URs in the sector generally have the collaboration of people belonging to recycling associations. The administrations and the recyclers of office agree on a series of days a week to be able to enter the waste rooms to recover materials. In this practice, an informal or verbal relationship between RU and waste pickers is usually maintained.

The links between the source and the recycler would allow for a greater organization of waste, which in turn would significantly reduce environmental impacts by including them more in the scheme of the circular economy, where policies are implemented that encourage the formation of social networks, environmental education plans, and incentives for social participation (Rodrigues, Boscov & Günther, 2020).

Sorting by waste pickers is ultimately the process that allows more waste to be recovered than other practices. This is because the above practices are only aimed at improving the

disposal of the material so that it can be selected, sorted and transported by the waste picker as a matter of course.

This practice supports and assumes the results of a process where the proper waste management is truly achieved. While the practices that should be carried out by residents, which would propose a more organised working scenario for waste pickers, which would be positive for recovery, remain insufficient as expressed by the managers and waste pickers contacted.

Thus, the culture of recycling in RU continues to be a path. The administrations have included in their PRM educational and awareness campaigns carried out through scheduled meetings and general assemblies of the groups. These campaigns have been carried out by associations and entities such as UAESP to show residents the proper way to separate waste from the home.

In addition to these pieces of training, one of the residential complexes commented that it invited the community to recycle in search of economic benefits, which worked until the city's waste collection scheme changed. Ten per cent of RU has distributed colored bags (black and white) to support the training and about 80 percent have used posters and billboards inside the blocks to illustrate proper separation, cleanliness in the garbage room, waste typology and proper use of the bags. It is worth noting that this advertising is consistent with the objective

since they claim to be made with recyclable materials.

It was also evident that the RUs work with cleaning companies in charge of the maintenance and good condition of the common areas. In this case, the practice of separation of materials by these personnel does not appear in any of the URs interviewed; although there is collaboration with the waste pickers to carry out the work, the cleaning personnel are only in charge of delivering the waste so that the waste pickers can clean the waste room or, in other cases, carry out the cleaning once the waste pickers have finished recovering the material they are interested in.

The waste management models or plans that the URs maintain are based on the consumption culture of the residents. 80% of the administrations said they implemented environmental education campaigns. However, only 25% of these mentioned that their PRMs applied this type of educational strategy as a fundamental pillar and highlighted experiences with entities with which campaigns had been carried out and the spaces in which they had been shared (assemblies, programmed meetings, etc.), among others.

⁹ ECA (Classification and Exploitation Station) installations technically designed with engineering criteria and economic efficiency, dedicated to the weighing and classification of solid waste that can be used, by means of manual, mechanical or mixed processes and which have the necessary environmental permits. (DNP, 2018)

The remaining 20% use other types of strategies, which was evident from the participant observation, and despite taking these measures such as demarcation of waste areas or advertising through posters, it was found that there was no planned implementation and many of the measures were taken only because of legislative requirements dictated by the Mayor's Office.

Among the alternatives, charging for the sale of the material is not a viable option. Recyclable materials could be taken from the RU to the Sorting and Processing Stations. However, in Colombia the material can only be given to the official recycler who is authorized to sell the material to the ECA⁹. Therefore¹⁰, the RU that establishes direct relations with official recyclers must do so voluntarily and without seeking profit. Accordingly, for the results of this research, no RU was found to be selling the material, arguing that it is not in their interest and because of the sanctions established by law.

Once the waste is generated, it tends to be undervalued by the URs as a whole, as the contact they have with the waste is practically

¹⁰ 596 of 2016, is the decree by which the Ministry of Housing, City and Territory regulates the operational scheme of the recycling activity and the transitory period for compliance with the obligations that must be met by official recyclers, formalized as providers of the recycling activity, in the public sanitation service (Ministry of Housing, City and Territory, 2016)

nil. In only 20% of UR, materials were used for educational purposes in a very sporadic way, such as activities like handicrafts based on recycled materials to decorate the residences at Christmas.

However, it is important to note that what is ultimately not recoverable ends up being managed by the sanitation system. All the RU make use of the local waste collection system and although there are some measures taken by private companies that have generated disagreements that have already been analysed, all the groups interviewed state that they deliver the waste to the systems without any exception.

In contrast to what is considered recoverable, the PRMs of the URs interviewed highlighted one practice, which corresponds to the route of separation of materials; a process that is known as the 'waste value chain' (Gonzalez Insua, M., & Ferraro, R., 2015) which would be the route taken by the materials from the homes to the waste rooms to be treated, either by waste pickers or by collection companies.

Thus, within the chain, the most frequent behaviour in the generation of RU waste is shown in the following figure:

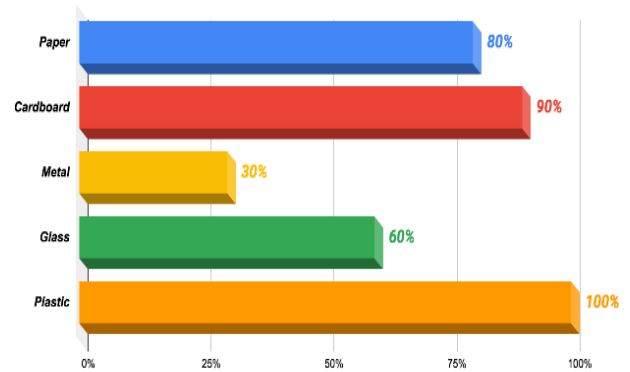


Figure 5. Most frequently generated materials. Own elaboration.

According to the above, 100% of RU states that plastic is generated inside the unit, 90% that cardboard is generated, 80% paper, 60% glass, and only 30% states that metal is generated many times as a result of the remodelling done inside the houses. It is important to note that this information is estimated through the daily observation of administrators, secretaries, and cleaning personnel since it is identified from the quantities of material that are deposited in the garbage rooms and/or that are classified by the official recycler.

Although there is no exact evidence of the quantities of material generated, disposed of and classified by household, thus limiting the information at the RU level, 70% of the units interviewed stated that they had seen some

improvement in waste management through the PRM implemented together with the practices applied, where two main purposes were found: to increase the recovery of recyclable materials and; to improve the use of disposal areas such as rubbish rooms by optimising waste management. Although PRM pursues these two objectives, the effectiveness of the practices applied has depended on the understanding and awareness of the inhabitants.

Thus, none of the RUs has been fully effective in complying with the recovery plans designed and disseminated, and managers agree that there is concern about the low participation of residents in PRM.

Awareness campaigns, along with posters, meetings and announcements through assemblies, have focused on preparing residents to sort their waste at home. However, the environmental culture and responsibility is still a weak aspect according to the perception of the interviewees and therefore the effective implementation of the plans remains limited. Also, it would be expected that the active participation of the community would help to deepen the aspects to be improved on the implemented PRMs so their intervention is fundamental.

RU administrators argue that the poor disposal, lack of commitment and participation of residents is even related to social characteristics such as age and family structure in which three population groups stand out: families composed of a father, mother and an average of two children; single people and older adults, stating that the latter group is the most complex to raise awareness of waste sorting while families composed of children tend to recognize, encourage and instil the importance of recycling.

Based on this characterization and information provided by the administrators concerning the conformation of the houses and the average number of inhabitants for each one of them, a rate of 3.6 kg/inhabitant of usable waste per day was found for UR, a figure that is surprisingly well above the SUI's¹¹ use reports where for the year 2019 an average of 0.04 kg/inhabitant of usable waste per day was estimated in Bogotá. It is important to note that concerning the SUI utilization figures it was necessary to have information from the waste pickers who participated in the study and obtain material from the SUIs studied.

These results not only represent a potential opportunity to strengthen the PRMs

¹¹ The Unique System of SUI Information of Public Home Services is a tool provided by the Superintendence of Public

Home Services for the reporting of information related to the exploitation activity.

within the RU but also to ensure a higher volume and quality of material for the recycler and a strong minimisation of waste going to landfill.

It is worthwhile to deepen in aspects of social characterization of RU since it becomes pertinent in front of the approach and application of different pedagogical strategies that allow improving the practices of separation in the source and adoption of the PRM considered vital when benefiting them in different ways allowing the sensitization of the residents for the strengthening of the disposition of residues in the rooms of garbage, reduction of the environmental impact, recognition and dignification of the work of the recycler and personnel of cleanliness, among others.

As waste pickers are forced to "break bags" to find recoverable materials within the unrecoverable and clean-up personnel must clean up the mess from the waste, PRMs offer more efficient disposal and management with better-distributed areas.

Although adequate separation continues to be an urgent issue for the RU, the use of materials is not seen as a task of interest by the administrations interviewed. Sixty per cent of RU stated that recycling is important, but that this 'benefit' should go to the waste pickers. Twenty per cent mentioned that it should be an external use for sectors of the economy that are dedicated to this

work and that focus on the mitigation of environmental impact.

As can be seen, there is no homogeneity in waste management among RU. Also, there is limited knowledge on the part of residents and administrators which leads to a certain inefficiency in PRM. It is important to highlight that monetary and physical factors such as infrastructure add to the identified drawbacks, making the application and implementation of strategies even more difficult.

The RU shows weaknesses in two points of their waste management: first, the planning phase of waste management programmes is not supported by any approach; in other words, the RU has not identified the goals to be achieved in the PRM and as a consequence, there are no criteria that allow them to measure or evidence results, only strategies are generated while waiting for a possible change in the community. Secondly, communication with residents does not achieve the desired response, although it is known that the greatest responsibility for waste separation and disposal falls on households, they remain unaware and indifferent to an adequate process.

Similarly, the RU processes that converge in waste management have two schemes: the internal one, where the practices and management of waste are found, and the

external one, where the elements outside the decisions of the RU on waste management are found, which have more to do with the institutionality but equally interfere in the strengthening of the management since there is no efficient compliance with the norm, for example to law 1801 of 2016 of the police code, chapter XI public health, concerning waste disposal and awareness plans (Congreso de la Republica, 2016).

As for the external scheme in Bogota, known as the sanitation or garbage collection system as mentioned above, waste is collected from the garbage rooms of the complexes, to be transported to the sanitary landfills. However, by 2018 this system will be complemented and a model of "containers" as illustrated in the image below:



Image 1. Waste containers. Own photograph.

The objective is to allow the RUs to leave their waste there to maintain a more pleasant landscape structure and to have the garbage collection trucks empty it at the established times. Even so, this strategy has not gone down too well

with residents, as 30% of RU say that paradoxically there is more disorder, dirt and worst of all a setback in the culture of waste management because the containers do not have a structure for separating materials which generates a mixture between recyclable and non-recyclable also causing discomfort among RU since its location generates confrontations for its use.

Evidence shows that waste that is disposed of unsorted and not used by waste pickers represents large volumes in containers, which hinders the process by requiring more vehicles to compact the waste, or some distances to be longer for collection and transportation, thus increasing transaction costs and falling heavily on gas emissions and increased fuel use (Yang, Li, Man, Peng, Zhang & Luo, 2019).

Now, under the new sanitation system, 20% of RU said that "abuses" have been committed and benefits such as the multi-user fee have been taken away. These sets had gone through a wasteful process to obtain discounts for the high level of material recovery, but in the new system as mentioned above this fee was eliminated which represents an increase in the toilet bills which discourages proper separation at the source.

In the same vein, the waste picker has also been affected to the extent that, if he does

not have the possibility of accessing the source, then he must go into the containers to extract the materials which, in many places in the world, represents a decrease in the obtaining of waste. It is estimated that under the container model only about 12% of material is recovered (Al- Khatib, I.A., Al-Sari', M.I., Kontogianni, S.,2020) which not only makes the work difficult and delayed but also degrades the work of the waste picker who is a key actor in waste management systems for the recovery of materials.

For this and other reasons, the whole of RU prefers to maintain direct links with recycling associations or waste pickers to take the material to ECAS or collection centres. In all of the analysis URs, the waste picker is employed to search for, separate and recover waste, and at least 50% of them are required to clean the bins and waste rooms.

It is important to mention that these agreements are quite informal, establishing verbal ties or other types of contracts but that they do not constitute an obligation in themselves, which means that for Colombia and other countries where informal waste picking is prevalent, there is a preference for the work of the informal waste picker (Steuer, B., Ramusch, R., & Salhofer, S. P., 2018).

For this study, the distribution of RU links with waste pickers is presented below:

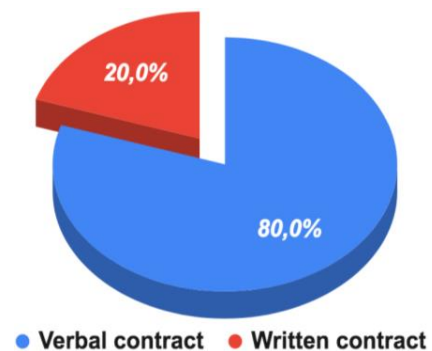


Figure 6. Type of linkage of the recycler to the UR. Own elaboration.

Only 20% of RU have a written contract with the waste picker and 80% have a verbal contract. However, despite the high level of informality in "contracting", it should be noted that waste pickers are often required to provide documents such as resumes, references and preferably membership in an association. This is because, despite an apparent sense of recognition and admiration for the work of the waste picker, there remains a degree of mistrust, mainly because of the comments or inconvenience this may cause to residents. Thus, those waste pickers with whom a link is made to allow access to the source are usually vulnerable to the waste picker.

The RU considers that the waste picker faces a difficult, risky, poorly paid, tiring and sometimes seen as a discriminated against and undervalued job, so they assume that recycling becomes an outlet during need. Some of them

call it "a work that nobody wants to do, but the need forces them".

This is how waste pickers end up being seen by managers as honest, hardworking, respectful and caring people. It is clear to them that without the work of the waste picker it would be impossible to mitigate environmental impacts. Thus, there is a desire for PRM to not only contribute to better disposal and separation but also to improve the conditions in which waste pickers currently carry out their work in each UR. Aware of its importance, within the RU, we have committed ourselves to the dissemination of various communications to inform residents about the PRM. Among the main means used are:

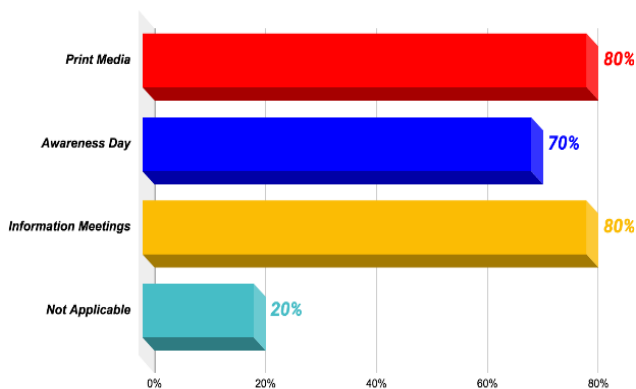


Figure 7. Methods of Dissemination of PRM. Own elaboration.

Printed media such as billboards, posters, flyers, among others, are usually the most used, as well as informative assemblies in which residents are invited to talks about waste management, separation is encouraged through the delivery of

coloured bags, and measures to be applied to PRM are explained.

The third most frequent method of communication is through awareness campaigns, where experts from entities such as the UAESP or members of recycling associations are invited to share spaces and knowledge. Finally, 20% of RU claim not to apply any kind of measures for the communication and dissemination of PRM.

In general, the RU believes that work should continue on these strategies because although 40% of them estimate that what has been implemented so far has allowed improvement in different aspects, there is still a need to raise awareness in the community that this is the main objective for immediate improvement in separation, directly impacting on the work of the recycler and the recycling scheme.

5. Conclusions

It is imperative to rethink the strategies that have so far been used with households to achieve adequate separation at source. It is evident that, although there are shortcomings in the disposal and separation of waste within the rubbish rooms of the UR, this would be substantially improved if there were appropriate disposal within the homes. This is why

strengthening communication and commitment mechanisms between administrations and households for more efficient results is fundamental for the adequate implementation and execution of PRM within the UR.

Within the strengthening of communication processes, it is essential to have the active participation of all people living in the RU to ensure better dissemination of information. Pedagogical strategies and the monitoring of their implementation must ensure that the information disseminated is understood and put into practice. These processes should be carried out jointly by the administrations, residents, waste pickers and cleaning staff since the latter are the ones who face the daily task of disposal, separation and cleaning of areas. It is essential to understand how the behaviour of households facilitates or hinders their work, impacting on other spheres of the recycling chain that many people do not know and ignore, and therefore perceive the process as unnecessary and/or cumbersome.

On the other hand, among the findings that show a marked misalignment between internal and external plans, it is important to establish policies that favour waste treatment by generating synergy between the actors involved in all links of the chain. A particular example is the implementation of the waste container system by the District, which has had a perception of discomfort and deterioration in

waste management. The implementation of policies should, therefore, include both households and residential units, waste pickers and conventional waste management schemes to identify their risks, relevance and effectiveness.

Within this synergy, it is important to deepen in studies like the present one where the academy participates, that allow identifying the dynamics of the households in Colombia in front of the waste disposal. Unfortunately, it is very difficult to access information on waste management per household, which prevents a more accurate look at the proposal of more appropriate public policies.

In the face of this, many administrators agreed that despite the strategies implemented so far, there is still little culture and awareness, so it would be worth considering more forceful strategies such as the collection of fines and payment of incentives within the UR, empowering the administrations to demand adequate compliance, although, without coercion, residents should ensure proper compliance with the rule, since the proper disposal of waste should not be an imposition but a natural behaviour of human beings.

Otherwise, it would be worthwhile to explore how to more appropriately involve informal waste pickers in the decisions that are made about PRMs. Attempts to allow waste

pickers access to the interior of the RU have been unsuccessful as their work has doubled and they have had to reallocate materials due to poor separation at source. Thus, improving the waste management system would allow waste to be delivered to the waste picker outside of the city with a direct link to the source.

Finally, it is important to note that this study is intended to serve as a starting point for other similar research, especially in similar areas in the city of Bogotá. The sample used may not be represented within the studies of RU and household behaviour because at a general level the lack of statistical information is very limited and there is no power to access more detailed information. However, the estimation by observation and collection of real information as well as the perception of the agents that are involved in this activity on a daily basis was fundamental for the construction of evidence on the behaviour of the residents in relation to waste management in RU and the identification of possible strategies for improvement and strengthening based on PRM.

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