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## Abstract

Low- and middle-income countries are lagging in research related to waste management initiatives and practices involving the informal sector and the problems faced by this population. Many case studies focus on waste management, but few deal with waste pickers' role and their formalisation process. In particular, there is a need to document the opportunities and barriers to transition for this population and the appropriate pathway from informal to formal work in the Latin American context. The objective of this article is to report the findings of an analysis of this transition in Colombia, where the institutional context explicitly promotes a formalisation pathway for waste picker organisations within the public waste management service in the waste picking activity. This analysis mixes quantitative and qualitative methods. The study draws on information from two main sources. First, primary data from a survey of individual waste pickers and waste picker organisations at the national level was considered. The second source was information analysis from workshops with waste picker leaders. The research's findings, conclusions, and recommendations compile barriers and opportunities for waste pickers, their organisations, and their formalisation. It is hoped that the findings will be used to guide similar studies in other developing countries with similar conditions for waste pickers.

**Keywords:** inclusive recycling, waste picker, waste management, informal sector

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## Introduction

Many cities worldwide suffer from deficiencies in solid waste management, especially with the activity of recovery and recycling of usable materials for their successful recirculation within value chains. Rarely are the activities included in waste management described and analyzed in detail from a social, economic, and environmental impact perspective. On the other hand, most people engaged in informal recycling in Latin America generally come from the most disadvantaged sectors and are vulnerable to poverty, discrimination, and human rights violations (Riviera, 2019). Although considerable progress has been made in terms of environmental regulations and the process of formalizing waste pickers (also known as recyclers), there are still significant challenges at the time of implementing such regulations.

The reality is that there is still limited participation by waste pickers in regulations and public policy. On the one hand, they contribute to a more effective collection of materials and receive economic retribution (Gutberlet, 2015). Still, on the other hand, political and legal decisions regarding waste management are made without considering informal sector workers (Riviera, 2019).

Consequently, these tend to favor mainly private interests and companies that want to profit from this business and rarely disadvantaged and vulnerable people and groups. Thus, although the informal sector is fundamental to waste management in cities such as Beijing (Steuer et.al, 2018), Johannesburg (Simatele et.al, 2017) and Rio de Janeiro (Tirado & Zamberlan, 2013), the reality is that public policy attempts aimed at favoring waste pickers have not been significantly favorable. Colombia is no exception to these labor and social dynamics since, generally, waste pickers work informally, with incipient technology, low income, and low capital investments (Tovar, 2018).

Given this scenario, formalization is an essential tool for strengthening waste pickers' organizations to attract independent waste pickers. The Colombian Supreme Court of Justice has played an important role in the progress that has been made in terms of regulations since, through a series of rulings, it determined that the ex-officio waste pickers should be subject to positive actions by the Government to guarantee their constitutional right to equal treatment and labor remuneration by the State. Despite this, as established by Tovar (2018) and as discussed later, in practice, what is observed is a process in the opposite direction, to the extent that the linkage to an organization does not represent an incentive made substantial benefits for non-associated waste pickers.

In this way, Colombia provides an opportunity to explore the progress of the process of inclusion of informal waste pickers in the official solid waste management system. Thus, progressively, potential advantages and challenges have been studied from the point of view of current legislation (Calderón et. al, 2021; Rosaldo, 2018; Fernadez, 2013) and detailed research

on solid waste management and processing (Ifigenia, & Julio, 2017). However, there is a lack of evidence on the real benefits for waste pickers belonging to an association and the current opportunities for their growth.

Thus, this paper has two objectives. First, to quantify the gains of being part of a waste pickers' association in terms of productivity, i.e., to conduct a quantitative analysis based mainly on sales per member. This analysis is based on data from a census of waste pickers conducted in 2019, covering nine cities in the country. The second objective is to identify opportunities for growth of the organizations through new sources of funding through projects financed by local authorities (Incentive for the Use and Transformation of Solid Waste, IAT in Spanish). For this purpose, a qualitative exercise was analyzed, including the views of both leaders of recycling organizations and public officials in the sector. These inputs, collected through workshops, expose strengths and weaknesses of the existing regulations that could not be found from a purely legislative analysis.

Thus, this article is structured in the first place using the theoretical framework and context where the relevant points of the regulatory history of recycling in Colombia and its consequences for the sector are mentioned. Secondly, it establishes the methodology used to carry out the econometric analysis and the IAT workshops.

## Theoretical framework and context

According to the National Administrative Department of Statistics (DANE), in 2019, 26.46 million tons of solid waste were generated in Colombia, of which 46.4% were of household origin, and 53.6% were from economic activities, representing an increase in the waste generation of 3.2% compared to 2018. 13.1 million tons were recovered; that is, 49.4% of the total waste generated (DANE, 2021).

In Colombia, the tons that are taken advantage of must comply with registration parameters that allow measuring the traceability of the amount of waste and the payment corresponding to the fee paid by the associations to waste pickers in the framework of waste management and formalization. Thus, the associations periodically report the information in the Single Information System (SUI) of the Superintendence of Domiciliary Public Services (SSPD). According to the 2018 records, it is estimated that 974,039 tons of materials were recovered in Colombia through taking advantage of the public sanitation service, information reported to the SUI by 266 associations of waste pickers across the country (SSPD, 2018).

Although these figures have grown in recent years, the difference between the 3.1 million outlined above and the administrative report of 2019 shows that most of the materials have been recovered and used informally or by initiatives of the same private companies. This

situation highlights the need to continue working from the different actors involved in more and better waste management policies and evaluate their impact. To date, a large proportion of usable waste is still undervalued limiting the scope of the strategies in the waste management framework.

Given the above scenario and taking into account that every year the country generates significant increases in waste generation, it is essential to highlight the implementation of waste management strategies; it is important to highlight the implementation of methodological bets such as the Integrated Solid Waste Management Plans (PGIRS) through resolution 754 of 2014 and the opinion of the National Solid Waste policy framed in CONPES 3874 of 2016, which have been created and consolidated as vehicles to improve the disposal and use of solid waste in the country attending to the current dynamics of production and consumption combining the environmental with the provision of the public sanitation service since it is a need of the institutions to work on the creation and implementation of policies that promote solid waste management (Aleluia & Ferrão, 2016). In other words, advocating for the reduction of non-usable waste, the proper management of usable waste and the provision of public service that includes the recycler as a fundamental part of this trade (Rodriguez et. Al, 2022)

After nearly 40 years of the prevalence of informal recycling in Colombia and despite the progress made in regulations, it is still necessary to print efforts to implement policies. This need is evidenced by: (i) the little decrease in the informality of waste pickers; (ii) the administrative, financial, and technological barriers faced by associations to comply with the formalization decree and link waste pickers through strong incentives; (iii) the incipient development of sorting and recovery stations; (iv) and the lack of adequate practices by households for the improvement of waste management processes. Public incentive through waste management policies is key for waste pickers' formalization, social inclusion, and welfare (Ghisolfi, V., Diniz, L., Ribeiro, R. & Helena, L., 2017). These agents have contributed to the improvement in waste management practices by minimizing problems of collection, sorting, and disposal of materials (Ezeah, C., Fazakerley, J. A. & Roberts, C. L., 2013).

## Regulations

Within the regulatory framework in Colombia, there are a series of legal measures that seek to recognize the work of waste pickers. More specifically, as shown in Figure 1, the recycling system is based firstly on Law 142 of 1994, establishing the domiciliary public utilities' regime. Second, there is Decree 2981 of 2013, which regulates the provision of the public sanitation service. Third, there is Resolution 754 of 2014 of Minvivienda and Minambiente in which the methodology for formulating, implementing, evaluating, monitoring, controlling and updating the PGIRS is adopted. In fourth place, there is Decree 1077 of 2015, which establishes the general guidelines of the operational scheme of the utilization activity and the transitory regime for the formalization of waste pickers by trade.

Finally, in fifth place, there is Decree 596 of 2016. This decree amends and adds Decree 1077 of 2015 regarding the scheme of the activity of utilization of the public sanitation service and the transitional regime for the formalization of waste pickers, and other provisions are issued. Among the significant achievements of said regulation is granting remuneration via fee to waste pickers who demonstrate that recycling is the economic activity to which their employment is dedicated. This payment is known as the recycling activity fee and is directly proportional to the productivity efforts determined by the amount of materials (kg) collected and reported. It should be noted that this recognition is made with the resources collected from the collection fee of the public sanitation service.

Figure 1. Colombian regulatory timeline

1994	Law 142 - Regime of domiciliary public services
2013	Decree 2981 - Regulations for the provision of public sanitation services.
2014	Resolution 754 Ministry of Housing, Ministry of the Environment
2015	Decree 1077 Ministry of Housing - Sole Regulatory Decree of the Housing, City and Territory Sector
2016	Decree 696 Ministry of Housing - Formalization criteria.
2018	Decree 2412 - Regulating the Incentive for the Use and Treatment of Solid Waste (IAT)
	Resolution 1407 - Obligations of the providers of waste collection services.
2020	Resolution 0176 - Regulation of access to IAT resources
2021	Decree 1345 - Extension of formalization period

This last decree becomes a critical for strengthening and encouraging formalization. This process must comply with a series of requirements that fall into several categories, including technical, operational, commercial, administrative, and financial aspects.

These activities are grouped into 8 phases, initially established to be fulfilled in 5 years, starting with registering as public service providers through the Single Registry of Service Providers (RUPS). However, as of Decree 1345 of 2021, this period was modified and, at the time of publication, it was established that the organizations of waste pickers that are in the process of formalization as providers of the recycling activity would have a term of eight (8) years to

progressively comply with the obligations required in the formalization process (Decree 1345, 2021).

On the other hand, it should be noted that Resolution 1407 of 2018 explains in greater detail some of the last steps of the formalization process. This regulation has several obligations for waste pickers in the process of formalization following Decree 596 of 2016 for the effective provision of the service of the recycling activity. Similarly, said Resolution regulates the use of paper, cardboard, plastic, glass, and metal packaging and obliges industries to formulate an Environmental Management Plan for Packaging and Packaging Waste. A regulation such as this one, framed in the use of materials, should be linked to the activity of waste pickers, generating greater participation in the recovery of these materials. Such characteristics would translate into an opportunity for the generation of higher income.

Finally, Decree 2412 of 2018 and Resolution 0176 of 2020 regulate the Incentive for the Use and Treatment of Solid Waste (IAT), where administrative aspects of the latter are calculated, and the eligibility criteria of the projects presented to access the resources of said incentive are stipulated.

## Methods

We consider two strategies to determine how the process of formalizing the recycling activity in Colombia has affected waste pickers. First, a statistical analysis of a survey designed and applied at the national level was conducted to measure critical aspects of waste picker associations and the people involved in the trade. Secondly, semi-structured interviews were conducted in focus groups with leaders of waste picker organizations and public officials whose functions relate to waste collection and management.

### 1.1 Statistical Analysis of the Survey of Associations and Waste Pickers

Regarding the collection of input data for this study, structured interviews were conducted with people who sell recycled material at retail, managers of establishments that sell recycled material, and waste pickers' associations, with which qualitative and quantitative information was obtained (Rodríguez-Lesmes et al., 2021). The survey was applied in 9 intermediate cities in Colombia with high volumes of recycled material reporting but for which few studies were available: Bello, Cartagena, Girardot, Soacha, Zipaquirá, Neiva, Pereira, Bucaramanga, and Ibagué. The study was based on the official model for conducting censuses of the waste picker population in Colombia (Minvivienda, 2016). The survey firm conducted a field search of places where recycled material was purchased (recycling warehouses), starting with an initial directory determined by the research team. Subsequently, the manager of each establishment was surveyed, and surveyors were stationed at the premises for several days, where they interviewed anyone who came to sell recycling (waste pickers). Waste pickers were asked for names of waste picker associations to which they belonged or of which they had heard. With

this information, the research team structured a more robust directory of potential associations, which were then surveyed by telephone. The survey period spanned from November 1, 2019, through December 21, 2019.

The data collection was framed within the formalization processes of waste pickers and organizations. The questionnaires were formulated based on a detailed analysis of two studies: the second national study on inclusive recycling conducted by the Fundación Avina (ANRI, 2017) and the final report on the characterization of organizations of waste pickers in the process of formalization conducted by the National University of Colombia (Universidad Nacional de Colombia, 2017). Based on these studies, an intervention matrix was constructed with 79 questions. The questionnaires include the respondent's socioeconomic characteristics to optimally understand their context to the details of the recyclable material collection process carried out by the person or association. The latter to know in detail the working conditions faced by the worker.

On the one hand, the number of commercial establishments obtained was 139 warehouses and recycling associations, where 54.7% of the organizations are constituted as small or medium-sized enterprises (SMEs), 31.7% as cooperatives or sales cooperatives, which for the analysis are considered as associations (in the light of Decree 596), and less than 2% as formal integrations. On the other hand, a total sample of 2,401 waste pickers responded to all the questions asked.

This study analyzes the information collected using linear regressions to explore the possible relationship between formalization and elements such as productivity. In the first instance, for the analysis of the responses obtained in the survey of warehouses and associations of waste pickers, the following regression was carried out:

$$Y_j = \alpha_0 + X_j' \beta + Z_j' \alpha + u_j \quad (1)$$

where  $Y_j$  corresponds to the outcome variables of interest  $X$  for the firm  $j$ : market power, Industry Concentration Index (IHH), and material traded per worker. As for the formalization conditions, we have the variables *Phase2*, *Phase3*, *Phase4*, and *Phase567*, which are binary and take the value of 1 for the associations that comply with all the requirements of each phase. Otherwise, these take the value of 0. Finally, regarding the nature of the respondent, typically the manager of firm  $j$ , we have the following variables  $Z$ : age, gender, having higher education (technical, technological, or university), and being associated with a cooperative.

On the other hand, for the analysis of the information collected from independent waste pickers, a series of regressions were carried out with the main objective of determining if there are real incentives for these workers to join a cooperative and consequently become part of a formalization process. For this purpose, the following regression was carried out:

$$W_i = \eta_0 + B_i' \eta + e_i \quad (2)$$

where  $W_i$  corresponds to the outcome variables of interest to the waste picker  $i$ : whether they are paid the fee recognized by the mayor's office to provide public service to waste pickers, received some kind of training, have any kind of health insurance, have taken loans from informal moneylenders, have some financial product, or have a human-powered vehicle. As



independent variables  $B_i$  we consider: membership in an association, gender, literacy, age, length of service, number of waste pickers known, the reported reason for working in waste picking sector, and being head of household.

## 1.2 Qualitative Analysis on Incentives for the Use and Transformation of Solid Waste (IAT)

In the year 2021, an IAT call was opened to attract system actors to present projects in the same year. In this framework, the German cooperation agency (GIZ) and AVINA Foundation organized participatory workshops to exchange experiences and effectively collect information. These workshops were developed with leaders representing waste pickers' organizations and representatives of the municipalities and organizations accompanying or supporting the formulation of these projects.

In these workshops, 133 people from 63 different institutions were invited, and most participants were women (63%). Of the total number of participants, 56 were leaders representing waste picker organizations from 17 municipalities or cities, representing 34 organizations or associations; 45 representatives of local government organizations from 20 municipalities or cities and 18 representing ten organizations or accompanying entities.

In this way, two workshops on the IAT Incentive were designed, in which ten guiding questions were generated for two target populations (see Annex). The first workshop was carried out with leaders of waste pickers' organizations from several cities in the country, and the second with public officials from different municipalities in charge of PGIRs and organizations that accompany or support waste pickers' organizations. Each of the workshops had a similar methodology, which consisted of two parts. The first part was developed in a general way for all participants, and the second was carried out in working groups of approximately 4 to 6 people.

## Results

### 2.1 Survey

#### 2.1.1 Waste pickers' Findings

Concerning the survey applied to the recycler population, it was found that 62% of the respondents affirmed that the main reason they engage in recycling is that it is the only work option they could access. The second reason is taste and family tradition, representing 30% and 8% respectively.

Regarding the form of employment of the waste pickers, 50% are hired through a verbal contract in the cooperatives. Meanwhile, written contracts prevail in small and medium-sized enterprises (SMEs) and formal integrations. In this context, 71.9% of the organizations tend to pay waste pickers for the material collected daily, while 8.6% pay weekly. In addition, only 24.6% of the organizations claim to be paying the fee recognized by the mayor's office to provide public service to waste pickers. On average, the organizations report paying around 3'000,000 pesos (902 USD apx.) in monthly salaries to their employees.

Finally, 74% are men, and only 25% are women (the remaining 1% are not categorized in either of these two groups). Additionally, the average age of those surveyed is 41 years old. Regarding education levels, only 80% have reached secondary school. It was also observed that the recycling activity is not associative, as 45% of respondents know only one or two other waste pickers. Likewise, only 7.4% belong to one of the waste pickers' associations, which shows that they tend to carry out the activity individually or with their families.

Regarding gender, on average, women's income from recycling is 14% higher than that of men. However, when analyzing other sources of income apart from recycling, it is evident that only women are engaged in care and household work, which could mean a higher level of vulnerability for them compared to men. Among the tasks above are ironing clothes, childcare, and domestic jobs. On the other hand, men predominate in the retail sector in jobs such as street vending and the provision of services such as construction, jobs that imply higher remuneration, reflecting an evident gender inequality among male and female workers in the sector.

Regarding waste pickers' links to associations, as shown in Table A1 in the annexes, it is estimated that belonging to an association increases the probability that the person's only source of income comes from recycling by 4 percentage points. In addition, there is an average increase of 70 percentage points in the fee for public services that the mayor's office recognizes for waste pickers through associations. On the other hand, being part of an association increases, on average, the probability of receiving training and being affiliated to the health system, as shown in Table A2 of the annexes. As a complement, within the financial information, it was found that the associates are less likely to obtain resources from informal moneylenders, which puts the physical and mental integrity of the providers at risk. This result is associated with a regression coefficient of 0.1 and a t-statistic of 0.001. Concerning income, it was found that, although the associates work fewer hours per week, their salaries tend to be higher compared to non-associated waste pickers. These figures show that, to some extent, it generates incentives for waste pickers to join the associations.

Another important factor is the intergenerational component that influences recycling work. Out of a total of 2,217 waste pickers, 1,173 indicated that none of the people with whom they live are engaged in recycling, while 1,044 people, 47%, responded that at least one other person is also engaged in this work. Despite this, it was found that the probability of receiving training is reduced in households where there are at least two waste pickers. Although it is important to mention that each additional person in the household involved in recycling is associated with

a higher probability of obtaining a higher individual income, the limited access to training could be influencing the possibilities that these people have of increasing their income.

In addition, other factors were considered in which differences between associates and non-associated could have been identified. These include the holding of financial products, a variable that, as shown in Table A2, was statistically significant for the analysis performed. This could impact other variables analyzed, such as the taking of risky financial products.

Thus, the above reflects a window of possibilities for improvement in which different mechanisms of action and initiatives can be explored to facilitate members' bankarization. This would reduce the percentage of waste pickers who take risky products and explore the possibility of generating credit opportunities for these same people in formal banking entities.

### 2.1.2 Association Findings

The survey of recycling associations showed that 37.8% of the associations surveyed reported that they fully use the tons collected. In comparison, 31.5% reported that only one of the tons collected each month is not used. On the other hand, regarding the main characteristics of the Cooperatives, it was found that 50% of the contractual links are made through verbal contracts, 48% through supplier contracts, and only 9.1% through verbal contracts.

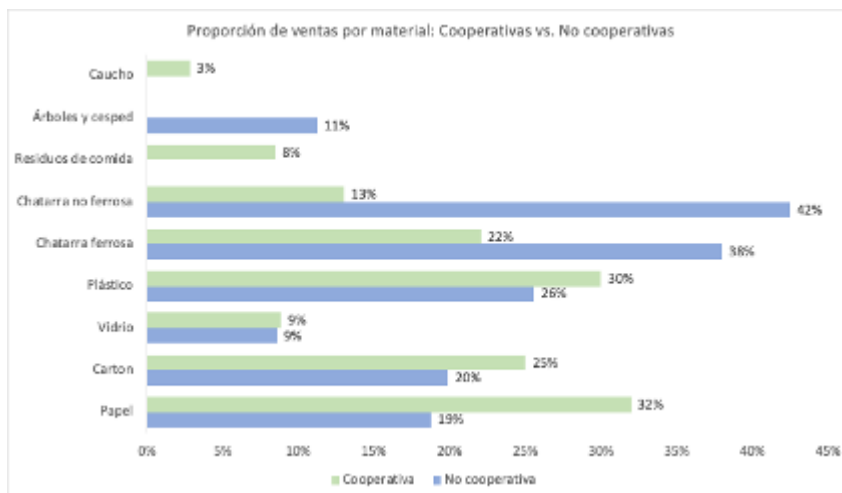
Regarding formalization, Table 1 shows the number of respondents, both cooperatives and non-cooperatives, concerning the levels of compliance with the requirements of each phase. To determine whether not belonging to a cooperative is significantly correlated to a lower probability of complying with the phases, a series of linear regressions were performed in which the dependent variables were each of the requirements of the phases. The independent variable for all cases was a binary variable that takes the value of one of the organizations that is not a cooperative and zero otherwise. This analysis allows us to conclude that the fact of not being cooperative is significantly correlated to a lower probability of complying with most of the phase requirements, as shown in the same table with the p-values of the regressions. There are only three requirements whose p-values are not significant: registration of tons transported, registration of tons harvested, and adoption of the uniform conditions contract of the public sanitation service (CCU) for the harvesting activity. From the above it is also possible to establish that there are providers of the recycling activity that comply with the requirements of Decree 596, which is the direct responsibility of the waste pickers' associations.

On the other hand, it is evident that there are no statistically significant differences in the level of education between cooperatives and other types of organizations. However, these other organizations report having received more training. Despite this, it should be noted that the

associations exceed the percentage of compliance with the phases for the formalization of waste pickers.

Regarding commercialization, the proportion of sales by material, from Figure 2 shows that for cooperatives who occupies the first place is paper with 32% of sales figure that represents a decrease of 23.4 percentage points with respect to the figures reported by the Unified Information System (SUI) the official system of the domiciliary public utilities sector of 2016. On the other hand, for the case of non-cooperatives who takes the largest share is non-ferrous scrap with 42%. Further, to evaluate whether there is a statistically significant relationship between the sale of these materials and the type of organization, a series of regressions were performed where the market share of each of the materials was taken as the dependent variable and as an independent variable a binary variable that takes the value of one if the organization is cooperative and zero if it is not. From this procedure, three significant differences in the proportion of sales per material were obtained when comparing cooperatives with non-cooperatives. Thus, as can be seen in Table A3 of the annexes, the difference in the proportion of non-ferrous scrap is significant at 1% and is associated with a coefficient of -0.294, while for paper and ferrous scrap the significance is 5% and is associated with coefficients of 0.132 and -0.159, respectively.

Figure 2: Proportion of sales by material



Source: Own elaboration

On the other hand, the survey of associations sought to find a relationship between the stages of formalization and their level of productivity. As a reference measure, a variable was created that relates the number of waste pickers in the association with the amount of material marketed. From this analysis it was concluded that the production per worker increases significantly in the associations when compared to warehouses. This is evidenced by the regression coefficient of 2.6 and the t-statistic of 0.007. On the other hand, the associations that are in the highest stages of the formalization process, the fifth, sixth and seventh, are also associated with higher levels of production, since they have more recycling machinery such as

balers and compactors. When reviewing whether there is a correlation between being in a higher phase and production levels, it is found that being in phase four is the only significant coefficient and therefore, it is concluded that there is no monotonic relationship between these two variables.

Finally, when finding the HHI taking into account production, i.e. the price per quantity of each material per association or warehouse, it is obtained that its relationship is statistically significant for the variable indicating whether recycling is the respondent's only source of income. Additionally, it is also significant for the variable indicating the number of people living with the respondent who are also engaged in this work. In other words, the existence of concentration of market enterprises increases the probability that more people in a household are involved in recycling.

## 2.2 Qualitative analysis of workshops related to the IAT Incentive for the Use and Transformation of Solid Waste (IAT)

In the present research we took the results of the IAT workshops mentioned above, in which it is possible to recover information from the actors involved in the recycling activity, including officials of the responsible municipalities. These officials are in charge of receiving the IAT projects and, together with a technical committee, evaluate them for approval.

It should be noted that Decree 2412 of 2018 of the Ministry of Housing, City and Territory (Decree 2412, 2018), in its Article 2.3.2.2.7.2. Scope of Application, highlights that this IAT Incentive would provide project financing opportunities to people providing the main and complementary activities of the public sanitation service, bearing in mind the provision of the public sanitation service. This puts grassroots waste picker organizations at a disadvantage, since they do not have sufficient academic training, as evidenced in the survey, and/or experience in project formulation. Although grassroots waste pickers' organizations in Colombia have been gradually meeting the requirements of each of the formalization phases, it has been noted that many waste pickers' organizations rely on Non-Governmental Organizations (NGOs) to advance in some phases of formalization, to formulate projects and also to seek sources of funding. In any case, the IAT incentive is promoted as an opportunity for grassroots waste pickers' organizations, and according to the regulations it is stated that for the allocation of resources to finance solid waste recovery and treatment projects, eligibility criteria are defined to ensure the participation of projects presented by waste pickers in the process of formalization as providers of the waste recovery activity.

In addition, it is important to highlight that all participants in the IAT workshops developed for the purposes of this research mentioned that the differentiating criteria for the differentiated evaluation of informal waste pickers were not clear. Although Article 2.3.3.2.5.3.6. of Decree 2412 of 2018 establishes the minimum administrative aspects to have in the organizations of waste pickers to be able to apply for the IAT incentive fund of the municipality, many times the portfolio of services, the database of users, the certifications in Labor Competencies for the

adequate management of waste, recycling and exploitation of the SENA and the elaboration and/or updating of the web page, are products of the organization that are fulfilled thanks to the support of the NGOs. Some organizations mentioned that sometimes they have to hire a third party, someone close to the waste picker organization, to carry out these administrative processes. In other words, although the IAT incentive promotes opportunities for waste pickers by trade and the strengthening of their facilities and/or operation, not all waste picker organizations at the national level will be eligible to apply for this type of funding, not without first having complied with all the formalization requirements of phase 6 of Decree 596 of 2016.

On the other hand, regarding technical assistance that could be provided from the Ministry of Housing, City and Territory to the waste pickers oficio around the IAT incentive, although the current environmental regulations in relation to the incentive mentions that the ministry within the framework of its competences, will provide technical assistance and will point out the differential criteria to have the projects presented by waste pickers oficio in the process of formalization as providers of the activity of use, workshop participants highlighted the need to establish regional technical tables to clarify administrative and technical doubts about the project presentation process, which continues to strengthen the need for capacity building so that waste pickers can adopt the measures of the related regulations.

### 2.2.1 Professional Waste pickers

With respect to the standard, among the most significant findings is that the municipalities' PGIRs are outdated and therefore there is a lack of coordination between the recycling activity, its characteristics and related costs. It is also noted that some municipalities have not yet made the calculations to modify the fee, so some of them currently operate the service, but without collecting the fee. Although the IAT incentive was established for implementation at the local level, the institutional disarticulation that hinders the implementation of the regulation was recognized, as well as the lack of updating of the Land Management Plan (POT) that hinders the land use permit. Currently, the IAT incentive is perceived as an instrument that supports the providers but not the waste pickers' organizations.

Regarding the formulation of projects, there are difficulties in the interpretation of the regulations, which makes it difficult to define the project and its objectives. At the same time, there is a lack of solid information for the baseline, feasibility study, projections, risk identification and measurement in the reduction of unusable tons, as well as low capacities for the formulation of projects in waste collection and treatment and high costs associated mostly to the lack of specialized capacities for the formulation of projects.

Secondly, the process of consultation with waste pickers is not easy and, in the case of having other organizations in the territory, there is a marked absence of responses to concerns raised for the presentation of projects.

However, in spite of the barriers mentioned above, some opportunities were also identified that, if worked on with more effort, could improve not only the perception of the formulation of projects but also their materialization; among these are the access to information regarding the results and concepts derived from the evaluation of the projects, the pedagogical dissemination of the norm, the clarity in the technical requirements, formulation and evaluation, and the accompaniment and training strategies that are carried out.

### 2.2.2 Municipalities and accompanying entities

When referring to the role of municipalities and institutions involved in making waste picker projects and waste management projects in general a reality, it can be inferred that unified criteria are required in the evaluation of projects as well as clarity about the available resources to be allocated, hard work and joint efforts between public and private institutions as well as the participation of academia in order to strengthen technical knowledge. It is also essential to guarantee the continuity of the work of the officials involved in these projects, at least during their execution and fulfillment, as well as accountability to know the scope, progress, products and/or results obtained, since many of them are not completed within the various government periods assigned and the budget ends up being allocated to other types of items or activities. It is imperative to be aware of the pending aspects both for the changes of Government and for those that occur within the participating entities, as this will allow the process to be resumed, optimizing time and working on pending aspects that must be addressed.

## Discussion and conclusion

The institutional scenario in Colombia allows studying the possibility of promoting the development of waste pickers' associations in the waste recycling scheme. Including these workers in the system can potentially be an alternative to reduce extreme poverty, contribute to the environment, and protect their human rights (WIEGO, 2019). This study explores whether, to date, inclusion has brought improvements for waste pickers, current barriers, and opportunities given by current legislation.

We found that despite the slow progress, which resulted in an extension of the original transition period in the law, waste pickers have clear benefits. For instance, those in the scheme worked fewer hours with a higher income per hour.

Our study also aims to understand the population of waste pickers in small cities, as studies have focused on the country's main cities. Compared to the Bogotá sample (Universidad Nacional, 2017), these waste pickers are in better socioeconomic conditions. For instance, our sample's mean educational attainment is higher than in the Bogotá study. Yet, Bogotá's development of cooperatives and other associations is substantially better than in the smaller cities. Still, their formal education levels are far from the regular population, limiting the possibility of associations competing on equal terms with other companies in an open market.

Apart from low educational levels, participation in the informal financial market, among others, limits the ability to invest in improving waste pickers' productivity and quality of life.

The development of inclusive organizations is further limited by the lack of reciprocal support between waste pickers and companies. This translates into low participation of organizations and associations in environmental decisions, their rights, and duties (Rodríguez, 2022).

The above results and the analysis of the discussions given by the key actors in the workshops lead us to the following recommendations:

(1) Financial inclusion of the waste picker population and their organizations through specific programs. We saw that organizations and their members tend to rely more on informal microcredit, which implies higher financial costs. Initiatives such as the granting of collateral by the State for investments associated with business strengthening can accelerate the expansion of organizations with potential but financially restricted.

(2) The use of financial incentives to accelerate investment in the productivity of warehouses or sorting and utilization stations. The design of these programs should consider costing exercises to ensure that these organizations obtain the capital levels that would allow them to be viable. In addition, there is a need for support in the formulation of successful projects that guarantee the fulfillment of three conditions: that they allow logistical and operational improvements, promote infrastructure development, and contribute to compliance with the PGIRS. This kind of accompaniment exists for the entrepreneurship sector in general, where there are incubators, entrepreneurship centers, and personalized counseling. Bringing this kind of support to the sector is essential for its success.

(3) Explore the possibility of promoting business strengthening exercises that make up for the deficiency in management skills. The country has several entities providing training to the productive sector, such as the *Servicio Nacional de Aprendizaje* SENA (National Learning Service) and local chambers of commerce. Seeking training opportunities offered by these entities could accelerate the organizational growth of the associations.

(4) Link other circular economy initiatives, such as extended producer responsibility and separation at source. Some entities have carried out, through their foundations, strengthening processes, but there is no responsibility derived from Resolution 1047 of 2018. The current status implies that companies can meet their goals without considering the inclusion component. Thus, there is an opportunity to get direct financial support for the organizations and managerial capital for formulating projects and structuring improvement plans.

The case of Colombia allows exploring the case of relatively broad legislation to achieve the inclusion of informal waste pickers in the formal solid waste management system. There are still essential barriers in financing and organizational management, where it is necessary to understand alternative ways and mechanisms to accelerate the processes. It is important to actively involve the recycler population in developing solid waste management regulations, thinking about ensuring equity among actors and the dignity of the recycler's work.



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Table 1: Compliance with formalization phase requirements: cooperatives vs. non-cooperatives

Formalization phase	Description	Cooperatives (waste pickers by trade)		Other providers of harvesting activities			Significance of non-cooperatives
		Quantity	Percentage	Quantity	Percentage	Coef	p value
Phase 1	RUPS		59%		39%	-0,19	0,05
Phase 2__1	Definition of the service area		74%		38%	-0,36	0
Phase 2__2	Record of Tons Transported		67%		62%	-0,06	0,52
Phase 2__3	Registration Tons of service area				34%	-0,36	0
Phase 2_4	Record Tons of Tons Harvested		68%		55%	-0,14	0,18
Phase 2_5	Record Invoice of commercialization of usable material		66%	45	46%	-0,19	0,05
Phase 2_6	Classification and Utilization Stations Registry (ECAS)		62%		23%	-0,38	0
Phase 3	CCU		53%		48%	-0,06	0,52
Phase 4_1	Portfolio of services		66%		21%	-0,45	0
Phase 4_2	Business Strengthening Plan		56%		13%	-0,43	0
Phase 4_3	User database		62%		38%	-0,24	0,02
Phase 4_4	Website		45%		10%	-0,34	0
Phase 5_1	Calibration record Scales		71%	58	55%	-0,16	0,1
Phase 5_2	Operational control		53%		12%	-0,4	0
Phase 5_3	Service delivery program		61%		10%	-0,5	0
Phase 6_1	Staff by employment category		62%		21%	-0,4	0
Phase 6_2	Collection micro-routes		50%		12%	-0,3	0
Phase 6_3	Certification of labor competencies		50%		9%	-0,4	0
Phase n_1	PQR				11%	-0,29	0
Phase n_2	Emergency and contingency plans		62%		32%	-0,3	0
Phase n_3	Financial information		48%		31%	-0,3	0
Phase n_4	Map of the service area in the MAGNA- SIRGAS reference system.		43%		8%	-0,3	0
<b>*Percentages are for each group.</b>							

Source: Own elaboration

## Appendix

Table A1: Characteristics of recyclers

Variables	(1)	(2)
	Ln and recycler value	Is recycling the only source of income?
How old are you?	-0.00803*** (0.00161)	-0.000588 (0.000386)
Can you read and write?	-0.220*** (0.0520)	0.0141 (0.0123)
How many years have you been working in the recycling industry?	0.00994*** (0.00227)	0.00167*** (0.000465)
Average time (hours) per trip	0.0105*** (0.00155)	
Do you belong to any of these associations?	0.772*** (0.0741)	0.0444*** (0.0130)
Female	0.117** (0.0454)	-0.0597*** (0.0139)
How many of them work with you in the recycling activity?	0.137*** (0.0139)	0.00806** (0.00270)
How many trade recyclers do you know?	-0.00113 (0.00169)	0.000143 (0.000307)
Reason==Taste	0.236*** (0.0443)	-0.0442*** (0.0119)
Reason==Family tradition	0.211** (0.0835)	-0.0560** (0.0216)
Are you a head of household?	0.279*** (0.0435)	-0.00809 (0.0108)
Constant	10.43*** (0.123)	0.972*** (0.0212)
Remarks	2100	1898
Standard errors in parentheses		
=* p<0.1	** p<0.05	*** p<0.001
* p<0.1, ** p<0.05, *** p<0.001		

**Table A2: Conditions of recyclers**

	(1)	(2)	(3)	(4)	(5)	(6)
	Are you paid the fee?	Have you received any training?	No health affiliation	Loans with gota a gota	Do you have any financial products?	Human traction
<b>Do you belong to any of these associations?</b>	0.690*** (0.0353)	0.0831** (0.0321)	0.00672** (0.00285)	-0.102*** (0.0302)	-0.0418*** (0.00671)	0.0915** (0.0412)
<b>Female</b>	0.0103 (0.00841)	-0.00779 (0.0156)	0.00395 (0.00420)	-0.0419** (0.0192)	-0.00596 (0.00831)	-0.00477 (0.0254)
<b>Can you read and write?</b>	-0.0164* (0.00887)	-0.0115 (0.0192)	-0.0213* (0.0121)	-0.0367 (0.0249)	-0.0163* (0.00913)	0.0340 (0.0299)
<b>How old are you?</b>	-0.0000350 (0.000315)	0.00215*** (0.000569)	0.000189 (0.000206)	0.00291*** (0.000666)	0.000515 (0.000319)	-0.00243** (0.000916)
<b>How many years have you been working in the recycling industry?</b>	0.0000948 (0.000437)	-0.00239*** (0.000621)	-0.0000595 (0.000162)	- (0.000857)	-0.00148*** (0.000419)	0.00310** (0.00133)
<b>How many of them work with you in the recycling activity?</b>	0.00823*** (0.00243)	-0.0135*** (0.00376)	-0.00367 (0.00233)	-0.0233*** (0.00458)	-0.00458** (0.00216)	0.0184** (0.00815)
<b>How many trade recyclers do you know?</b>	-0.00210*** (0.000350)	-0.000462 (0.000665)	0.000101 (0.0000787)	0.0100*** (0.000803)	-0.000933*** (0.000225)	-0.000751 (0.000946)
<b>Reason==Taste</b>	0.0296*** (0.00786)	-0.00417 (0.0154)	0.00760* (0.00448)	0.152*** (0.0218)	0.0483*** (0.0105)	-0.119*** (0.0248)
<b>Reason==Family tradition</b>	0.0116 (0.0108)	0.0718** (0.0306)	0.0141** (0.00636)	0.242*** (0.0350)	0.0723** (0.0225)	-0.0705* (0.0427)
<b>Are you a head of household?</b>	0.00560 (0.00631)	0.0187 (0.0146)	-0.00431 (0.00673)	0.175*** (0.0176)	0.0207** (0.00785)	0.275*** (0.0228)
<b>Constant</b>	0.0204 (0.0151)	0.0418 (0.0291)	1.012*** (0.0113)	0.0118 (0.0347)	0.0265** (0.0134)	0.270*** (0.0479)
<b>Remarks</b>	1894	1894	1319	1902	1902	1902
<b>Standard errors in parentheses</b>						
="* p<0.1	** p<0.05	*** p<0.001"				
* p<0.1, ** p<0.05, *** p<0.001						

**Table A3: Proportion of sales by material**

	(1)	(2)	(3)	(4)	(5)	(6)
	Paper	Carton	Glass	Plastic	Ferrous scrap	Non-ferrous scrap
<b>Cooperative</b>	0.132**	0.0510	0.00290	0.0443	-0.159**	-0.294***
	(0.0392)	(0.0519)	(0.0558)	(0.0454)	(0.0575)	(0.0651)
<b>Constant</b>	0.187***	0.199***	0.0855**	0.255***	0.380***	0.424***
	(0.0224)	(0.0282)	(0.0328)	(0.0245)	(0.0248)	(0.0308)
<b>Remarks</b>	86				102	
<b>Standard errors in parentheses</b>						
* p<0.1, ** p<0.05, *** p<0.001						