Who cares for the environment?
Recycling and Composting in Bogotá

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My purpose in this paper is to identify who cares for the environment in Bogotá and the social and cultural determinants of environmental care. These questions address two concerning issues: climate change and the care crisis.

Regarding climate change, Bogotá produces approximately 7,500 tons of trash daily. 51% is organic waste, which might be compostable, and almost 30% are recyclable materials (Special Administrative Office of Public Services of Bogotá, 2017). Out of this waste, 6,300 tons end up buried in landfills. According to the Air Quality Observatory of Bogotá (2020), the decomposing process in landfills is the city's third most significant greenhouse gas emission source. Hence, the Bogotá City government has been working on a Comprehensive Solid Waste Management Plan (PGIRS) to develop a circular economy that includes recycling and composting as critical elements. In this context, the Cultural Affairs Office (2021) implemented the Environmental Culture Survey (ECA) to understand how citizens relate to the environment. Among other questions, the survey asked about waste management. The findings were encouraging: in Bogotá, 76% of the citizens say that they recycle, and 26% compost. However, there is still much room for improvement. For instance, the survey also showed that 41% percent of the people do not know which products are recyclable (which means they might be recycling incorrectly), and 21% think recycling is useless because industries are the biggest polluters.

Bogotá does not have a formal citywide system for recycling. Nevertheless, approximately 1 thousand tons of waste are recycled daily (Special Administrative Office of Public Services of Bogotá, 2017). This enormous amount of material is saved thanks to Bogotá citizens' environmental culture and the work of 30,500 informal waste pickers (Florez, 2022). Regardless of the positive environmental impact of their labor, waste picker's work conditions are precarious, "the majority do not have

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personal protection elements to carry out their work, they are not affiliated with the social security system that protects them against the various contingencies that may arise, and sometimes they must work much more than 8 hours a day" (Orduz, 2022, as cited in Florez, 2022). These labor conditions are symptoms of what has been described as the care crisis: (1) increasing demand for care (Dowling, 2020), including environmental care–such as recycling or composting; (2) a global economic model that systematically "free-rides" care labor (Fraser, 2016) or underpays it (Folbre & Smith, 2017); (3) enormous inequities in terms of who assumes this type of labor –primarily women (Federici, 2012).

Seeking to address the care crisis, in 2010, the Colombian Congress signed Law 1413, also known as The Care Economy Law. This law defined care jobs as activities performed within the household or neighborhood that are essential for the economy but unpaid and unrecognized. The law considers a broad range of activities as caregiving: cooking, dishwashing, direct care for other humans, community services, and more. Recycling and composting are among these care activities. Following the Law 1413 request, the National Department for Statistics (DANE) measured the amount of time invested in care labor, estimated its economic value, and identified the number of caregivers in the country. 2017 Care Economy measurement revealed the size of the informal care phenomenon in Colombia: almost 29 million citizens (out of approximately 48 million population) invest a daily average of 5 hours and 42 minutes in unpaid caregiving labor; the economic value of this labor equals 20% of the country's gross domestic product; and most of the activities are assumed by women (DANE & UN-Women, 2020).

In response to the care crisis, the Bogotá City government developed The Care System (Decrees 237 of 2020 and 415 of 2023), a policy that seeks to redistribute, recognize, and reduce caregiving time. The policy slogan is "caring for the ones that care for us." The novelty of this care policy is that it does not focus on the care recipient (kids, seniors, the environment...) but on the caregivers–a shift in Bogotá's care policies genealogy (Sepúlveda, 2017). The Care System supports caregivers through welfare infrastructure and divides care into four categories: direct, indirect, emotional, and environmental care. In the latter category, recycling and composting appeared again as care activities.

In summary, climate change and the care crisis intersect in recycling and composting. Identifying who cares for the environment in Bogotá is essential to develop targeted interventions that promote a circular economy in Bogotá (PGIRS's objective) and reduce, redistribute, and recognize caregiving time–as the Care System aims.

CIRCULAR ECONOMY IN BOGOTÁ

As previously mentioned, Bogotá operates without a formal recycling or composting system, relying instead on citizens' self-organization and environmental culture. But how does this unique system function? Drawing from the Environmental Culture Survey (2021), a statistically representative survey of Bogotá, this section provides a brief overview of the Bogotá circular economy system.

Recycling and composting start when families separate their trash in recyclable and non-recyclable items. 68% of the people say they do it because it is "good for the environment," and 21% say they do it because they "want to help waste pickers." Usually, the trash is kept in the kitchen for a few days or a week. 71% of bogotanos say they have more than one trash can for doing so.

Citizens learn in many ways how to recycle and compost. For instance, there is an influencer from Bogotá, Marce la Recicladora ('Marce the Recylcer'), with more than half a million followers on Instagram. Marce personifies a waste picker and teaches her audience how to recycle and compost, among other environmental care activities.

Families collect household trash with two different destinies. On the one hand, mostly in black bags, they collect the trash for the public waste management trucks that take it to the Bogotá landfill called 'Doña Juana.' There is a long history of negative environmental and social impacts of Doña Juana. For instance, in 1997, a part of the landfill exploded due to the accumulation of gases of waste decomposition, and 1.2 million tons of trash ended up in the Tunjuelito River and the backyards of hundreds of families (Barrios, 2022). On the other hand, usually on white bags, bogotanos collect recyclable items for waste pickers. 66% of the people know the exact day the waste picker passes by their street, and 37% of the people in Bogotá personally know the waste picker who collects their recyclable material.

Photography 1. Waste Picker collecting recyclable items

In this sense, half of the question, 'Who Cares for the Environment,' has already been answered: 30,500 waste pickers walking all over Bogotá collecting recyclable material–as in Photography 1. The following sections of this paper are dedicated to answering the other half of the question and identifying the people who separate their trash in their homes and give the recyclable items to waste pickers. In other words, in the following sections, "recycling" and "composting" refer to the behaviors or actions of separating the trash (recyclable from non-recyclable) within the households.

LITERATURE REVIEW

The literature reviewed for this paper suggests four groups of factors that might predict environmental care behaviors (composting and recycling): demographics, capabilities, motivations, and opportunities.

Regarding demographics, the UN-Women & DANE (2020) report on caregiving in Colombia reveals an enormous difference between men and women in the average time devoted to care duties. Women invest 7 hours and 14 minutes daily in activities such as cooking, cleaning the house, and caring for family members. In contrast, men invest 3 hours and 25 minutes. The same report calculates that the average age of informal (direct) caregivers in Colombia is 33 years. Thus, gender and age might be relevant factors to tackle the research question.

Robert West and Susan Michie (2020) posit that, generally, behaviors are driven by capabilities, motivations, and opportunities–they called this the COM-B model. They divide the capabilities into psychological and physical ones. A physical capability might be having enough strength to perform composting activities, like chopping a big can of food scraps. An example of a psychological capability is knowledge. For instance, knowing which products are recyclable might predict recycling behavior. The motivations are also divided into two categories: automatic and reflective. On the one hand, an automatic motivation is throwing the waste into the first bin that one sees without checking if it is for

recyclable items. On the other hand, an example of reflexive motivation is the people who recycle because they are consciously concerned about global warming. Finally, the opportunities are physical, when the behavior is influenced by a material element, like a trash bin nearby, or social, when a formal or informal norm influences the behavior, like a law for mandatory recycling.

Geiger et al. (2019) extensively review studies that identify recycling-related factors. In contrast with West & Michie, they conclude that "among individual factors, behaviour-specific factors (i.e., recycling self-identity, personal norms towards recycling, past recycling, and perceived behavioural control over recycling) were better predictors of recycling than general factors (i.e., general knowledge, general attitudes, general personal norm)" (Geiger et al., 2019, p. x). Moreover, they posit that contextual factors, such as having a bin for recyclable materials, are also predictive of recycling behavior.

METHODOLOGY

The Environmental Culture Survey (Bogotá's Cultural Affairs Office, 2021) is the primary dataset for this research. It is a comprehensive survey that asks about citizens' environmental behaviors in Bogotá, and it is statistically representative citywide (2200 observations, 2% margin of error, and 95% confidence interval).

Since the research question asks for a causal explanation, the methodology relies on logistic regression to identify the main factors that predict the behaviors of recycling and composting–both dummy variables. The methodology is broken into three steps. Following the literature review, the first step is to select the independent variables of the regression. In other words, to look for the demographics, capabilities, opportunities, and motivations. The second step is to run cross tables and Chi2 tests to identify possible relations among variables. The third step is to run the regressions and drop the variables that do not predict the behaviors of interest. The following formula summarizes the regression model (adaptation from Field et al., 2012, p. 314):

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i} \ldots + b_n X_{ni})}}$$

All the variables in the model are dummies. The dependent variables $P(Y)$ are "*recycle*" and "*compost.*" The independent variables (X) are presented in Table 1. The "b" are the coefficients of each independent variable.

Table 1. Variables

Variable	Type of variable	Survey question	Dummy
recycle	Dependent	In general, do you recycle?	1: yes 0: no
compost	Dependent	Do you do compost?	1: yes 0: no
female	Independent (demographic)	To which gender identity do you identify?	1: yes 0: no
bin	Independent (physical opportunity)	Do you have more than one trash bin?	1: yes 0: no
noprejudices	Independent (Reflexive motivation)	Do you agree with the following statement? "Waste Pickers are dangerous people." *Proxy for having prejudices against "recicladores" (waste pickers community). **In Bogotá, if one wants to recycle, one has to interact with the "recicladores" (waste picker community).	1: no 0: yes
senior	Independent (demographic)	41 years old or older	1: yes 0: no
belief_impact	Independent (Reflexive motivation)	Do you agree with the following statement? "Since industries are the ones that pollute the most, the efforts made to care for the environment are insignificant." *Proxy for the beliefs about the impact of individual behavior	1: strongly disagree or disagree 0: strongly agree or agree
k_product	Independent (capabilities)	Is the eggs' box a recyclable item? *Proxy for knowledge about the recyclable products	1: yes 0: no
lvl_4	Independent (demographic)	The socioeconomic level of the house is related to how expensive the household services (water, gas, and electricity) are in the household's zone. *Proxy for the household income. From level 1 (lowest) to level 6 (highest).	1: middle-high income 0: other
animals	Independent (Reflexive motivation)	Do you share your home with a domestic animal?	1: yes 0: no
university	Independent (demographic)	College degree	1: yes 0: no

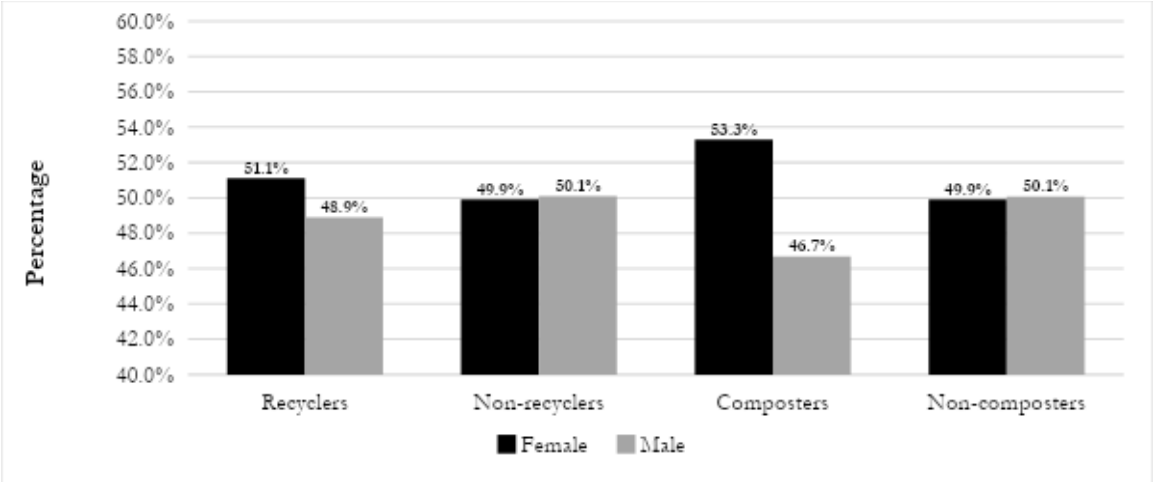
Source: Environmental Culture Survey (Bogotá Datos Abiertos, 2021).

RESULTS

Figure 1 illustrates the cross tables results for behavior *vs.* gender identity. On the one hand, among those who recycle, 51.1% identify themselves as females. On the other hand, in the group of people who do not recycle, 49.9% identify themselves as females. There are just 1.2 percentual points of difference and the Chi2 test is not statistically significant. The same distinction for the compost

behavior is 3.4 percentual points and also statistically insignificant for the Chi2 test. In other words, according to the cross tables, gender identity is likely not a good factor for predicting recycling behavior.

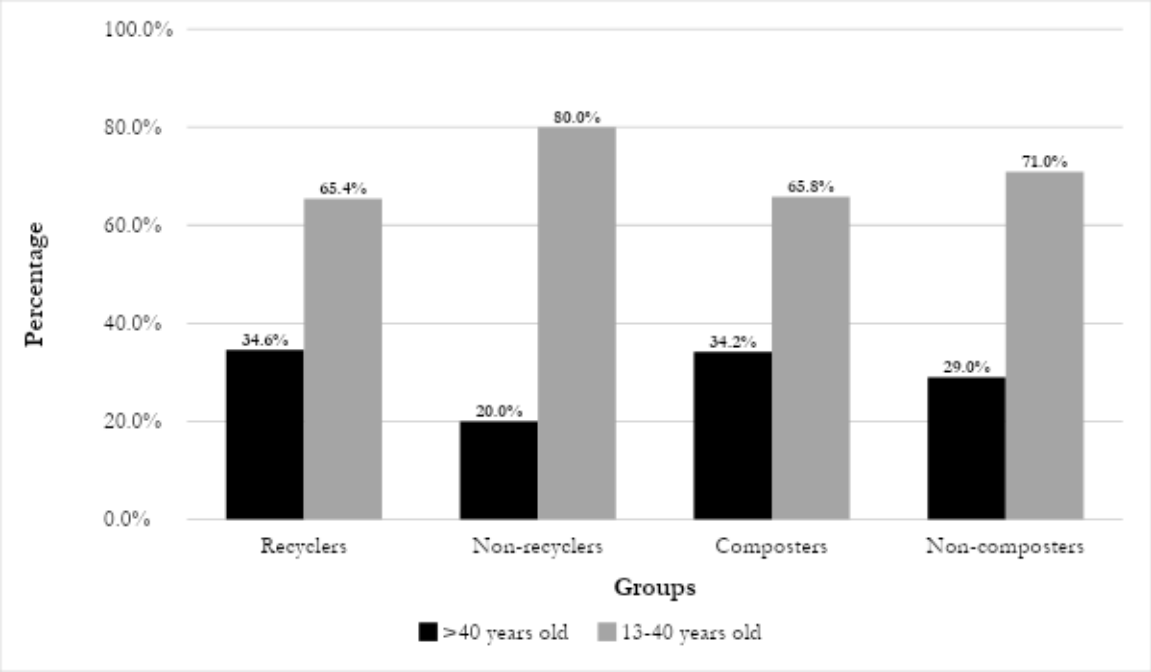
Figure 1. Recycling/Composting *vs.* gender identity.



Data: Environmental Culture Survey (2021), n=1803

Regarding behavior *vs.* age (see Figure 2), among those who recycle, 34.6% are seniors (>40 years old). In contrast, among the people who do not recycle, 20.0% are in that range of age–14.6 percentual points of difference. Furthermore, the Chi2 test is statistically significant (p-value=0.000). The same difference for the compost behavior is 5.2 percentual points and is also statistically significant for the Chi2 test (p-value=0.047). Thus, age might be a good factor for the model.

Figure 2. Recycling/Composting *vs.* Age.



Data: Environmental Culture Survey (2021), n=1803.

Table 2. summarizes all the cross tables and Chi2 tests, including the ones illustrated in Figures 1 and 2. All the selected independent variables but gender identity might work well as factors in the recycling regression. However, the results for compost are different; the only tests with p-values below 0.05 are for the dummies senior, animals, and university.

Table 2. Cross tables, Dependent *vs.* Independent variables.

	Recyclers (1)	Non-recyclers (0)	Composters (1)	Non-composters (0)
female (1)	51.1% **	49.9% **	53.3%	49.9%
other (0)	48.9% **	50.1% **	46.7%	50.1%
Noprejudices (1)	86.2% *	80.0% *	84.7%	84.2%
Other (0)	13.8% *	20.0% *	15.3%	15.8%
Senior (1)	35.6% ***	20.0% ***	34.2% *	29.0% *
Other (0)	65.4% ***	80.0% ***	65.8% *	71.0% *
belief_impact (1)	75.9% *	69.3% *	74.3%	73.8%
other (0)	24.1% *	30.7% *	25.7%	26.2%
k_product (1)	84.0% ***	72.3% ***	82.2%	80.0%
other (0)	16.0% ***	27.7% ***	17.8%	20.0%

lvl_4 (1)	17.8% ***	9.4% ***	15.5%	15.2%
other (0)	82.2% ***	90.6% ***	84.5%	84.8%
Animals (1)	62.7% ***	53.3% ***	67.2% ***	57.6% ***
Other (0)	37.3% ***	46.7% ***	32.8% ***	42.4% ***
University (1)	29.2% ***	17.7% ***	22.1% *	27.0% *
Other (0)	70.8% ***	82.3% ***	77.9% *	73.0% *

Notes Chi2 test Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 3. presents the results of the logistic regression that explains recycling behavior, and Table 4. does the same for composting behavior. The independent variable "*bin*" was excluded from the final model because it generates an endogeneity problem since, to recycle, one must have more than one trash bin.

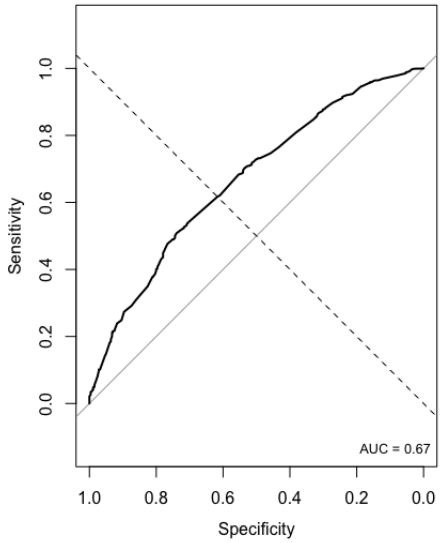
Table 3. Recycle logistic regression model

Variable	Coef	Exp(Coef)	Std. Err.	Z value	Pr(>|z|)	VIF
(Intercept)	-0.85062	0.4271515	0.19696	-4.319	1.57e-05 ***	
female	0.01209	1.0121626	0.10825	0.112	0.911079	1.011325
noprejudices	0.41024	1.5071778	0.14326	2.864	0.004190 **	1.023315
senior	0.91725	2.5024031	0.12845	7.141	9.28e-13 ***	1.030936
belief_impact	0.27023	1.3102609	0.12078	2.237	0.025262 *	1.021971
k_product	0.70739	2.0286993	0.12915	5.477	4.32e-08 ***	1.010330
lvl_4	0.60496	1.8311753	0.17421	3.472	0.000516 ***	1.048912
animals	0.29049	1.3370796	0.10938	2.656	0.007912 **	1.013666
university	0.55245	1.7375132	0.13598	4.063	4.85e-05 ***	1.045502

Notes	Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Nagelkerke R^2	0.109
P-value, Hosmer & Lemeshow test	0.1932
Accuracy	0.72268
ROC AUC	0.67

According to the model, "*female*" is not statistically significant for predicting recycling behavior. However, the remaining variables are significant, with a p-value below 0.05. The results for each variable are the following ones: people older than 41 years are 2.5 times more likely to recycle; people who know which products are recyclables are 2.0 times more likely to recycle; people with a middle-high income are 1.8 times more likely to recycle; people with a college degree are 1.7 times more likely to recycle; people who do not have prejudices against waste pickers are 1.5 times more likely to recycle; people who believe that individual actions matter are 1.3 times more likely to recycle; and people living with animals are 1.3 times more likely to recycle. According to the Z value, the strongest predictor is the age.

Figure 3. ROC Curve for Recycle



How good is the model? Firstly, according to Nagelkerke's statistic (0.109), the model explains 10.9% of the variation in recycling. Secondly, the Hosmer test has a p-value above 0.05, which means it is statistically insignificant, which is the desirable result to meet the requirements of the goodness of fit (GOF). Thirdly, the accuracy of the model is 67%. Lastly, the ROC curve has an area under the curve (AUC) of 0.67 (see Figure 3). In this case, the ROC Curve suggests the model works better than flipping a coin–which is an AUC of 0.5.

Table 4. Compost logistic regression model

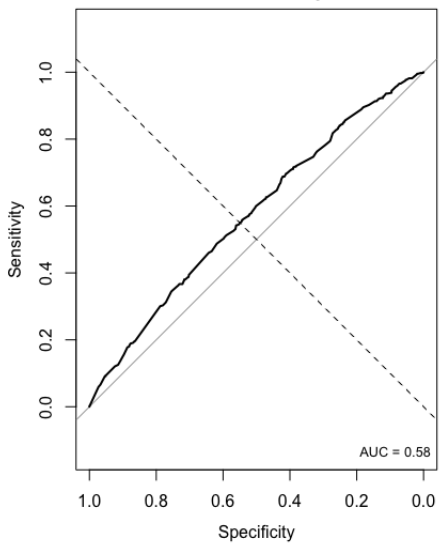
Variable	Coef	Exp(Coef)	Std. Err.	Z value	Pr(>|z|)	VIF
(Intercept)	-1.605063	0.2008769	0.218835	-7.335	2.22e-13 ***	
female	0.123597	1.1315600	0.111133	1.112	0.266069	1.011325
noprejudices	0.008713	1.0087507	0.154774	0.056	0.955109	1.023315

senior	0.246351	1.2793491	0.118816	2.073	0.038136 *	1.030936
belief_impact	0.022763	1.0230243	0.127442	0.179	0.858239	1.021971
k_product	0.138074	1.1480609	0.143464	0.962	0.33583	1.010330
lvl_4	0.096814	1.1016553	0.159736	0.606	0.544458	1.048912
animals	0.403918	1.4976807	0.116718	3.461	0.000539 ***	1.013666
university	-0.300528	0.7404270	0.136309	-2.205	0.027471 *	1.045502

Notes	Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Nagelkerke R^2	0.02
P-value, Hosmer & Lemeshow test	0.8247
Accuracy	0.75652
ROC AUC	0.58

All the variables included in the compost's model were not statistically significant except for being older than 41 years old, living with animals, and having a college education. The (exp) coefficients' interpretation is the following: people older than 41 years are 1.2 times more likely to do compost; people living with animals are 1.4 times more likely to do compost; and people with a college degree are less likely to do compost.

Figure 2. ROC Curve for Compost



According to Nagelkerke's statistic (0.02), the model explains 2% of the variation in doing compost. The Hosmer test has a p-value above 0.05, which is the desirable result to meet the requirements of the goodness of fit (GOF). The accuracy of the model is 75%. Lastly, the ROC curve has an area under the curve (AUC) of 0.58 (see Graphic 1). In this case, the ROC Curve suggests the model works similarly to flipping a coin (AUC of 0.5).

DISCUSSION

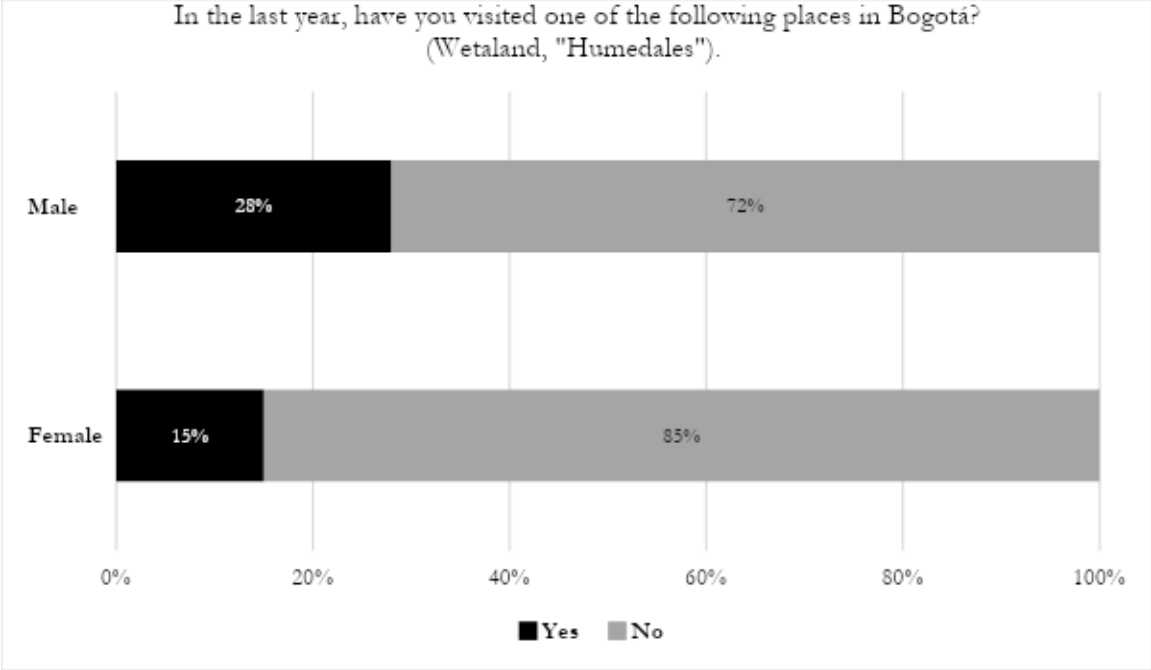
The recycling model's results are intriguing. Some of the findings are aligned with the literature. For instance, knowledge and narratives indeed predict recycling behavior. However, the model also differs from some of the reviewed articles, for instance, the results for gender identity. In the following paragraphs, I will discuss the effect of each factor and suggest tentative explanations or frameworks to interpret the results.

Concerning age, the model suggests that people older than 41 years are more likely to recycle; in fact, this is the most relevant variable of the model (highest Z value). As with all the results, it would be pertinent to expand the understanding of the care experiences through qualitative research. For now, a hypothesis is that people younger than 40 years old are busy with other forms of care; as DANE & UN Women's (2020) report confirms, the average age for direct caregiving (such as taking care of a family member) is 33 years old. So, people younger than 40 might have less available time for environmental care.

A surprising finding that differs from my expectations and the literature is that there seems to be no gender gap in recycling. "Female" was not a statistically significant factor. However, the following elements must be considered to interpret these results. Firstly, the model does not consider the frequency of the behavior. In other words, generally, women and men respond similarly when asked if they recycle, but the frequencies may differ. Secondly, women invest more time than men on direct and indirect human caregiving duties–on average, 3 hours and 25 minutes of difference (DANE, 2020). In other words, women have less available time for recycling and composting. These might also be reflected in different types of interactions with the environment. For instance, Figure 4 shows a considerable gender gap regarding who visits natural spaces (parks, forests, wetlands, etc.). Thirdly, as Doreen Massey (1994) posits in *Space, Place, and Gender*, "geography matters" (p. 23) in terms of division of labor. Environmental care differs from other forms of care in terms of the places and spaces in which it is performed. For instance, direct and indirect care is carried out within the household. In contrast, recycling, composting, and gardening (environmental care) usually require a community garden or a park open to the public eye and susceptible to other social arrangements. In that regard, in *Paradise Transplanted*, Pierrette Hondagneu-Sotelo (2014) posits that in California, "residential maintenance gardening is a racialized and gendered occupational niche, the masculine parallel to paid domestic work" (Hondagneu-Sotelo,

2014, p. 23). Expanding the understanding of the geographies of informal care in Bogotá might be an exciting research avenue for further explorations.

Figure 4. Visiting wetlands ("*humedales*") in the last year *vs.* gender identity



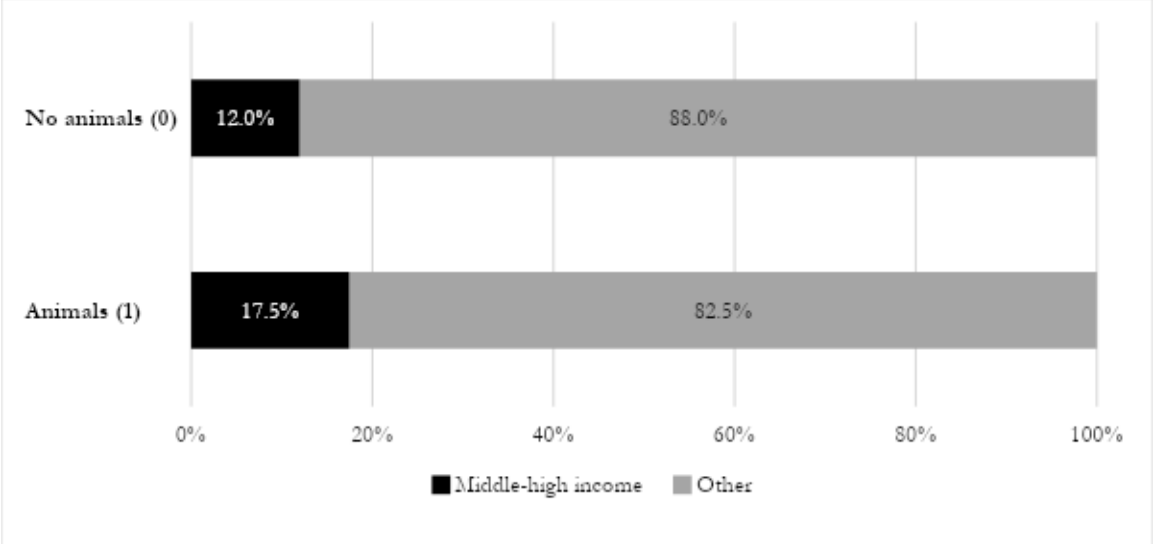
Source: Executive Document Environmental Culture Survey (2021).

What is the relationship between having pets and recycling behavior? According to the results, people living with animals are 1.3 more likely to recycle. Besides, the Environmental Culture Survey also asked about motivations for caring for animals: 48% of *Bogotanos* responded that they do it because they consider animals "sensitive life beings with emotions." Put differently, there is a notorious narrative among people in Bogotá about recognizing and caring for other forms of life beyond humans, which might be affecting our interactions with the environment. Haraway (2016) suggests that exploring these multispecies stories is relevant for expanding our understanding of socio-environmental ecologies, "companion species [for instance, dogs and humans] infect each other all the time…for good and for ill. Bodily ethical and political obligations are infectious, or they should be" (Haraway, 2016, p. 29). How might a closer relationship with animals affect human behaviors in Bogotá, particularly environmental caregiving?

Another hypothesis for explaining the relationship between animals and recycling is an existing association between having a pet and the socioeconomic level of the household. In the group of people with NO animals in Bogotá, 12.0% are middle-high income, whereas the percentage is 17.5% for those living with animals (see Figure 5). Moreover, as shown by the regression results, people with middle-

high incomes are 1.8 more likely to recycle. Performing environmental care often costs money. Living with a dog or cat is an additional cost for families. Recycling demands residing in a neighborhood or building with enough space to store recyclable and compostable material; sometimes, it even requires a monthly fee for managing the waste. These results might reflect another effect of income inequities: barriers to performing environmental care.

Figure 5. Socioeconomic level *vs.* animals



Source: Executive Document Environmental Culture Survey (2021).

Aligned with the literature, narratives and knowledge are significant factors for recycling. West & Michie (2020) posit that to perform a behavior, one needs to know how to do it. According to Table 3, people who know which products and materials are recyclable are two times more likely to recycle. As mentioned, there is still room for improvement: 41% of the people in Bogotá still do not know how to recycle correctly (Bogotá Cultural Affairs Office, 2021). Regarding narratives, people who do not have prejudices against waste pickers are 1.5 more likely to recycle. In other words, prejudices do affect environmental care. This is relevant since the survey shows that 17% of Bogotá's population considers waste pickers "dangerous" (Bogotá Cultural Affairs Office, 2021).

Another relevant narrative is the one that suggests that recycling is useless because big corporations are the greatest polluters. The model demonstrates that people who differ and believe in the impact of individual actions are 1.3 more likely to recycle. Indeed, big corporations are big polluters and people must know the main sources of waste. However, this should be informed to citizens carefully. As the model demonstrates, this narrative might affect the willingness to perform environmental care behaviors–this is a discursive challenge for environmental activists and policymakers.

Lastly, regarding the compost, because of the statistics of the model (Nagelkerke, Hosmer & Lemeshow, and ROC), it is better to avoid profound interpretations of the coefficients. A tentative explanation is that the Environmental Culture Survey (2021) focuses primarily on recycling.

CONCLUSION

To conclude, most people recycle in Bogotá (3 out of 4), but there seem to be unequal experiences in environmental care. This paper suggests some entry points for more profound qualitative inquiry and policy intervention from the Care System and PGIRS perspectives: (1) gender and income-related inequities in environmental care; (2) youth experiences in recycling and composting; (3) narratives and knowledges about waste in Bogotá; (4) a deeper understanding of the relationships between direct, indirect, emotional, and environmental care, as mentioned, a hypothesis is that direct caregivers have less time for environmental care; (5) multispecies stories of care; and (6) varieties of environmental care–the factors for composting and recycling seem to be different.

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