

Education and sustainable behavior

A case study

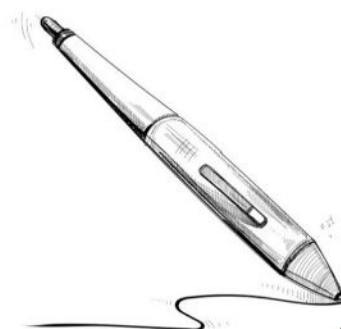
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Síntesis

Justificación	Climate change is one of the biggest concerns that humankind faces in modern times. Several strategies have been proposed by the Intergovernmental Panel on Climate Change and the World Bank to tackle the negative effects of climate change. This paper aims to analyse the influence of education on people's sustainable behavior as one of the key strategies to tackle climate change. A multinomial probit model for ordinal responses is employed using data from the Perception Survey on the Quality of Life of the municipality of Sabaneta, Colombia, year 2018. The heterogenous effects of education on sustainable behaviors are analyzed based on people's socio demographic characteristics. The findings have important implications for policy initiatives aimed at increasing friendly actions for the environment through education.
Argumentos centrales	<ul style="list-style-type: none">• Individuals with more schooling degrees tend to show further levels of sustainable behaviors• The positive effect of further education on the increasing levels of people' sustainable behaviors is heterogeneous around individual's socioeconomic characteristics such as age and residence location• Compared to individuals in the control groups, people under 55 years of age and residents who live in rural areas, tend to show greater sustainable behaviors as they educate more.
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Abstract

This paper analyzes the influence of education on people's sustainable behavior as one of the key strategies to tackle climate change. A multinomial probit model for ordinal responses is employed using data from the Perception Survey on the Quality of Life of the municipality of Sabaneta, Colombia, year 2018. The heterogeneous effects of education on sustainable behaviors are analyzed based on people's socio demographic characteristics. Findings show that individuals with more schooling degrees tend to show further levels of sustainable behaviors, although differences exist between groups: people under 55 years of age, and residents who live in rural areas tend to show greater sustainable behaviors, compared to individuals in the control groups, as they educate more. These results have important implications for policy initiatives aimed at increasing friendly actions for the environment through education.

Key words: sustainable behavior, education, ordered multinomial probit model, climate change

Introduction

Global warming is one the biggest concerns that humankind is facing in modern times (IPCC, 2018). Around thirteen million tons of plastic waste end up in the oceans every year (United Nations, 2018). Almost 2.100 million tons of waste are produced each year, of which 16% is recycled and reused (Semana, 2019). More than 80% of sewage water that arises from human activity is dumped into rivers or seas without any treatment (United Nations, 2015); an action that causes water contamination, and put at risk the lives of thousands of people who lack a basic sanitation system

For the Intergovernmental Panel on Climate Change (IPCC for its acronym in English), global warming has motivated people to adopt sustainable behaviors with the environment, in search of a reduction of the destructive effects of people's daily activities (IPCC, 2018). Current generations have a greater commitment to the development and sustainability of the planet, due to in part to the intergenerational impact that their behaviors will have for future generations, as defined from the *Report of the World Commission on Environment and Development "Our common future"* by the Brundtland Commission (United Nations, 1987).

To minimize the risks of negative impacts from climate change, it is necessary to strengthen governance at multiple levels, including institutional capacity, environmental policy instruments, technological innovation, transfer, and mobilization of financing (IPCC, 2018). Something that is crucial to the IPCC is the need to change people's behavior and lifestyles. Human beings must adopt behaviors capable of caring for, conserving, and making sustainable use of resources without skipping the fact that they are surrounded by factors that condition their behavior (World Bank, 2015). For this reason, people cannot assume *per se* they act independently from their environment, their social conditions, or the opportunities other people can access.

There are several studies that have analyzed the favorable behaviors or attitudes of people towards the environment, including Ogunbode & Arnold (2012), Franzen & Meyer (2010), among others. With the identification of factors that have the largest influence on people's friendly behavior with the environment, it is possible to improve not only the design and implementation of development interventions and policies that focus on human choice and behavior (Bank World, 2015), but also the strategies that focus their attention on helping human beings to become more aware, respectful, and responsible with the care of the environment, and the great challenges that their behaviors impose (Richardson, et al., 2009).

Education has been recognized not only as an engine of growth and economic development (Haddad et al., 1990). More recently, education has been regarded as a fundamental strategy to generate social awareness of climate change (caused largely by global warming), as well as to help people adapt to new scenarios resulting from environmental degradation (UNESCO, 2014). Education increases knowledge about people's habitat and its threats, fosters pro-environmental convictions and values, and generates changes in lifestyles and behaviors that are accelerating the deterioration of the planet (Severiche et al., 2016; Villadiego-Lorduy et al., 2015). Therefore, education is a form of social mobilization that can help us find solutions to environmental problems (UNESCO, 2014), whether directly or through knowledge spillover effects that arise when a large proportion of population is educated (Franzen & Meyer (2010).

In the Sustainable Development Goals (SDG), one of the goals established for 2030 was to ensure that all students acquire the necessary theoretical and practical knowledge to promote sustainable development (United Nations, 2017). This goal is transversal to other SDGs, because without the adoption of sustainable lifestyles (through the teaching of individual and collective actions that promote economic growth without putting at risk existing natural resources), it is not possible to achieve diverse SDGs associated with the environment: clean water and sanitation,

affordable and non-polluting energy, climate action, underwater life, and life in terrestrial ecosystems, among others.

Sabaneta is a municipality in the Department of Antioquia, Colombia, that has been working on institutional actions to counteract climate change. The Municipal Development Plan of Sabaneta (Antioquia) "Sabaneta de todos" (2016-2019) identified the main environmental problems that afflict the municipality, including air and water pollution, garbage pollution, among other issues (Alcaldía de Sabaneta, 2016). This plan shows that environmental problems are highly determined by factors that concern the individual sphere, such as ignorance of sustainable practices and care for the environment, little sense of appropriation of natural wealth, and little environmental culture reflected in poor management of waste (Alcaldía de Sabaneta, 2016). Furthermore, this plan highlights the importance of education to combat environmental problems; a fact that has been evidenced in different empirical studies (Lubell et al., 2007; Ogunbode & Arnold, 2012), although without the necessary identification of existing differences in individual sustainable behaviors between population groups (people with different age, place of residence, gender, among other socio demographic characteristics).

The aim of this article is to analyze the factors that influence on the sustainable behaviors of residents from Sabaneta. Particularly, the paper seeks to evaluate two complementary research hypotheses. First, if the increase in people's sustainable behaviors (saving water and energy, separating solid waste, taking reusable bags to shopping) are influenced by the inhabitants' greater levels of schooling. Second, if the hypothetical increase in people's sustainable behaviors from higher schooling levels differs between individuals within various socio demographic groups, particularly, between residents from rural and urban areas and between adults (older than 55) and no adults. This second hypothesis arises from the need to capture the socio demographic diversity of Sabaneta. This study is of significant interest to the community, as Sabaneta presents

a high climate risk (Corantioquia, 2020), which can be lessened through people' environmentally friendly behaviors. Moreover, this analysis can guide educational strategies that can help with the climate change, based on the recognition of differences between individuals.

To analyze this problem, an ordered multinomial discrete choice model is used. Data from the Survey of Citizen Perception of the Quality of Life in the Municipality of Sabaneta, year 2018, are used considering the responses provided by residents in the environment module (Observatorio Territorial de Sabaneta, 2021). It is important to note that this study does not include analysis on sustainable behaviors that arise from companies' social responsibility, as the paper's focus is on the individual as an agent of change in his/her own environment.

This paper, first, carries out a literary review on the relationship between people's schooling levels and sustainable behaviors. Subsequently, the data are examined and the model to estimate the core hypotheses of this paper is presented. Finally, empirical results are discussed, and some conclusions are offered.

Literature Review

There is a strong interest in the literature to study the factors that influence on people' sustainable behaviors as a part of several strategies that can help to mitigate the negative effects of climate change. Behavioral science theories have examined ways of intervention to change certain behavioral patterns of people (Michie et al. 2011). These intervention strategies can improve individual behaviors toward a long-term environmentally sustainable development (Morra Imas & Rist 2009).

Factors analyzed that influence on people' sustainable behaviors include economic aspects such as income (Scott & Willits, 1994; Franzen & Meyer, 2010); socio demographic variables, including age (Ogunbode & Arnold, 2012; Martinsson & Lundqvist, 2010), gender (Martinsson

& Lundqvist, 2010; Casey & Scott, 2006), place of residence (Martinsson & Lundqvist, 2010), and population density (Franzen & Meyer, 2010). For the United Nations Educational, Scientific and Cultural Organization (UNESCO), education is an element of economic and social development, which has been recognized as a factor capable of conditioning human behavior to prevent environmental degradation (UNESCO, 2014). This paper focuses on the literature that has investigated the influence of education on people's sustainable behaviors at the aggregate and individual levels.

Lubell et al. (2007) base their study on the collective interest model of mass political action, which has been widely used to explain phenomena such as political protest and other collective action problems (Finkel et al., 1989; Finkel & Muller, 1998). With a national survey applied to US citizens, the study empirically analyzes the motivations that guide people's behavior in favor of the environment in a mass context. From the estimation of an ordered probit model, the results show that education is highly associated with large levels of sustainable behaviors and civic skills that seek to face costs derived from global warming.

Martinsson & Lundqvist (2010) use data from the annual SOM (Society, Opinion, Media) surveys, which are carried out by the University of Gothenburg from 1986 on nearly 6,000 Swedish citizens between 15 and 85 years of age. The aim of Martinsson & Lundqvist is to determine if the cosmopolitan vision of ecological citizenship can be applied (where citizens adopt green civic virtues), or if, on the contrary, people can have environmentally friendly behaviors without having sustainable attitudes. The study uses correlations between the cosmopolitan vision and various socioeconomic variables, including the level of schooling. Results show that people can have friendly behaviors with the environment without having significant changes in attitude. In particular, the study finds that individuals with low levels of education exhibit more ecological practices than those with a medium-low education level; and

those with a high education present a considerable increase in the score of sustainable behaviors with the environment.

Franzen & Meyer (2010) analyze individual-level and country-level factors associated with environmental concern in the populations of twenty-six countries that participate in the International Social Survey Program (ISSP), period 1993 and 2000. Using multilevel models, Franzen & Meyer (2010) find that the population's concern regarding care for the environment is not influenced by educational participation at the country level; nonetheless, at the individual level they find that the years of education of individuals does have a positive and statistically significant association with the environmental concerns of these individuals. This last result is in line with the study by Álvarez & Vega (2009), who found that educational levels have a strong and significant influence on people's environmental behavior. Thus, Franzen & Meyer (2010) note that education is an important strategy to build environmentally responsible behaviors in developed countries as higher rates of environmental concern arise.

The study in Pennsylvania (United States of America) by Scott & Willits (1994) analyzes various factors that can influence on people's environmental awareness, including the values of the New Environmental Paradigm (NEP) designed by Dunlap & Van Liere (1978), and education, among other variables. The analysis of 3,632 people is carried out through the design and application of a multiple and bivariate correlation regression. The results allow to conclude that education has a direct association with environmental awareness, although the results are not statistically significant at the conventional levels. The results also show that the NEP variable (composed of the environmental attitudes and behaviors of people), is not a good predictor of the environmental behavior of the individuals.

Casey & Scott (2006) apply a questionnaire to 292 participants from 126 urban and rural locations in Australia, with the aim of evaluating residents' environmental behaviors and their

levels of ecological concern. Using multiple regressions and Pearson's correlation test, Casey & Scott (2006) find that higher educational levels of the participants are positively associated with greater levels of ecocentric concerns for the environment and with more ecological behaviors.

Ogunbode & Arnold (2012) evaluate the level and distribution of environmental awareness in the central city of Ibadan (Nigeria) as a function of various explanatory factors, including social status, which was represented by the individual's level of education and occupation. The study carries out comparisons between population categories using the t-test and non-parametric tests, including the Mann-Whitney U (to check heterogeneity of two ordinal samples) (Quispe, et al, 2019) and the Kruskal-Wallis analysis of variance (to test if a group of data comes from the same population) (Quispe et al, 2019). Results show that the level of schooling is strongly associated with environmental care, and with a stronger inclination to participate in pro-environmental behaviors.

In the study carried out in China by Chen et al., (2011), national data from the General Social Survey of 2003 is used and treated from a multivariate statistical analysis. The NEP scale of values is also used, on which a logistic regression is applied to estimate the effects of environmental attitudes and socio demographic attributes of the respondents in each pro-environmental behavior. The study by Chen et al. (2011) concluded that more schooling plays a key role in people's increase of environmental attitudes, because it not only facilitates the understanding of environmental problems, but also promotes individual responsibility for the environment.

The analysis carried out by Pothitou et al. (2016) in Peterborough (England) finds a positive correlation between knowledge on greenhouse gas (GHG) emissions, energy savings, and actions to reduce energy use. The study clarifies that, although schooling is not directly investigated in the paper, key elements of education are investigated, including environmental knowledge,

individuals' habits, and consumers' attitudes toward domestic energy. Once the study applies the Spearman's rank correlation test and Fischer's exact test on a database of 249 respondents, Pothitou et al. (2016) conclude that knowledge plays a crucial role in changing energy consumption behavior and purchasing patterns.

The study by Villadiego-Lorduy et al. (2015) identifies the factors that lead to the negative behaviors of people toward the environment, leaving out people's environmentally sustainable behavior. The study, that focuses on wetlands, finds that low levels of community education contribute to these flooded areas of land degrading over time, losing their ecological importance. In the study, about 46% of homes in the area have some individuals with incomplete basic studies; a fact that significantly affects the degree of understanding that inhabitants have about the effects of their actions on the environment (Villadiego-Lorduy et al., 2015).

Casalo et al. (2019) explore the association between general environmental attitudes and various pro-environmental behaviors. The study uses multilevel or mixed-effects logistic regressions on survey data that add several covariates, including educational level. The study results suggest that, having a high school degree and a university degree is positively associated with all pro-environmental behaviors of individuals, except for garbage separation, which is significantly associated only with having a university degree.

Overall, there is consensus in the literature on the positive association between individuals' behaviors in favor of the environment and their levels of education; notwithstanding, there is a need for assessing whether these pro-environmental actions, driven by education, differ between individuals, and whether these potential differences can be explained by individuals' socio demographic factors. The data and model used to analyze if greater sustainable behaviors are associated with higher levels of education (the first hypothesis of this paper), and if there are

differences around the effects of education associated with various socio demographic factors (the second hypothesis), are explained in the next section.

Data and Model

Data

This study employs the Citizen Perception on the Quality-of-Life survey (CPQL) applied to residents in the Municipality of Sabaneta, year 2018 (Observatorio Territorial de Sabaneta, 2021). This is a survey by conglomerates that analyzes 415 residents of Sabaneta over 18 years of age. The CPQL survey follows the multidimensional measurement methodology on the quality of life carried out by Colombia's National Planning Department; a practice that avoids measurement biases due to potential political influences in the municipalities. The sampling error of the survey is 5%. The population of Sabaneta in 2018 is around 54 thousand inhabitants over 18 years of age, of which 75% reside in the urban area, and the remaining 20% live in the rural area; 23% of the population is over 55 years of age; and 59% and 32% of residents live in strata 2 and 3, respectively (Observatorio Municipal de Condiciones de Vida de Sabaneta, 2018). The survey asks the following questions associated with the environment (sustainable behaviors), which are utilized in this study: Do you take reusable bags to the supermarket or to the grocery store to avoid using plastic bags? Do you separate waste in your home? Do you save water in your home? Do you save energy in your home?

Based on the answers given to the questions above, a variable called *sustainable behaviors* in Table 1 is created. This is an ordinal scale variable that mirrors people's levels of commitment to protect the environment. Score 4 is awarded when the answers given to the four questions are affirmative, suggesting that the resident has very high sustainable behaviors. Score 3 is given when at least three out of four questions are affirmative. Score 2 is awarded to individuals who

have two affirmative answers and two negative answers. Finally, Score 1 is assigned to people with three or four negative answers (grouping both possible answers in one category), which suggests there is low awareness on environmental sustainability.

Table 1. Classification of Sustainable Behaviors

Sustainable behaviors	Score	Description (affirmative/negative answers to environmental questions)
<i>very high</i>	4	Four affirmative answers
<i>high</i>	3	Three affirmative answers
<i>medium</i>	2	Two affirmative answers and two negative answers
<i>low</i>	1	Three or four negative answers

Source: own elaboration based on statistics from the CPQL survey

Descriptive statistics from the answers provided in the survey show that 33% of people have *very high* sustainable behaviors, 35% show *high* sustainable behaviors, 24% have *medium* sustainable behaviors, and the remaining 8% of people adopt *low* sustainable behaviors. These figures show that most people in Sabaneta have *very high* and *high* environmentally friendly behaviors. The survey has various questions on the socioeconomic aspects of people from Sabaneta that are included in this study as covariates. Statistics from the survey associated with residents' educational levels show that 2.5% of people have postgraduate studies, 18% have undergraduate studies, 23% have technical and technological studies, 55% have primary and secondary school studies, and the remaining 1.5% do not have any degree of schooling. It is worth noting that Sabaneta had one of the lowest illiteracy rates in the country in 2015, close to 2.3% of population (Pérez-Gutierrez & Montoya-Serna, 2016).

A crosstab analysis in Table 2 shows that people’s sustainable behaviors vary between them according to their schooling levels. Based on the figures, residents with postgraduate studies show the highest level of sustainable behaviors *very high* and *high* (80% of the population), followed by residents with undergraduate studies (70.6%), primary/secondary/no studies (67.9%), and technical studies (62.5%). The figures show, as a starting point, that people from Sabaneta that adopt the lowest level of sustainable behaviors *low* is that with primary/secondary/no studies (11.5%), followed by residents with achieved technical studies (8.3%) and undergraduate studies (2.6%). None of the residents with postgraduate studies show *low* levels of sustainable behaviors.

Table 2. Crosstab Analysis of Sustainable Behaviors by Educational Level

Study level	Sustainable behaviors			
	Percentage of population (%)			
	very high	high	medium	low
Primary/secondary/no study	31.20	36.75	20.51	11.54
Technical	30.21	32.29	29.17	8.33
Undergraduate	38.67	32.00	26.67	2.67
Postgraduate	40.00	40.00	20.00	0.00

Source: own elaboration based on statistics from the CPQL survey

Model

To analyze the factors that influence on the sustainable behaviors of residents from Sabaneta, particularly, the role of educational levels on these behaviors, the multinomial ordered probit model is employed. This model fits the ordinal nature of the dependent variable created in this

paper, and the coefficients are estimated using the maximum likelihood method (Hill et al., 2011). The idiosyncratic error term assumes a standard normal distribution, for which the probit function is used (Hill et al., 2011). The probit function also allows for the presence of correlations between ordered alternatives, which is desirable to skip the independence of irrelevant alternatives assumption (Wooldridge, 2010). This paper follows the study by Lubell et al. (2007) who use an ordinal response model to predict the environmental behaviors of individuals and their determinants.

In the ordered probit model of this paper, the probability of observing outcome i among 4 alternatives of sustainable behaviors (P_i) corresponds to the probability that the estimated function (z_j) is within the cut points κ_i and κ_j as shown in Eq. (1).

$$P_i = P(\kappa_i < z_i^* < \kappa_j) \quad (1)$$

Where z^* represents the set of 4 scores of sustainable behaviors of people from Sabaneta:

$$z^* = \begin{cases} low = 1 & \text{if } z_i^* \leq \kappa_1 \\ medium = 2 & \text{if } \kappa_1 \leq z_i^* \leq \kappa_2 \\ high = 3 & \text{if } \kappa_2 \leq z_i^* \leq \kappa_3 \\ very high = 4 & \text{if } z_i^* > \kappa_3 \end{cases}$$

The Cumulative Density Function of the Gaussian standard normal distribution at different cut points is used to estimate the probability of having the i -th respective sustainable behavior among the set of behaviors defined in this paper. The latent/index variable z_j is linearly associated with the covariates (x) included in this paper plus a random error term (u_j) as showed in Eq. (2).

$$z = \beta_0 + \beta_1 technical + \beta_2 undergr + \beta_3 postgr + \sum_{i=4}^n \beta_i x_i + u_j \quad (2)$$

The covariates *technical*, *undergr*, and *postgr* in Eq. (2) are key dummy variables that identify if the person holds a technical degree, a bachelor degree, or a postgraduate degree, respectively (the control group includes people with primary school degree, secondary school degree, and no schooling). Of particular interest in this paper is the analysis of estimated coefficients $\hat{\beta}_1$, $\hat{\beta}_2$, and $\hat{\beta}_3$ to identify whether people from Sabaneta with further schooling levels tend to have greater sustainable behaviors, as most studies in the literature have identified.

Several control variables are included in the matrix x_i of Eq. (2). The dummy variable *age55* identifies whether the individual is older than 55 (the control group includes people who are between 18 and 55 years of age); *male* equals 1 if the person is male (the control group is female); *urban* equals 1 if the person lives in the urban area of Sabaneta (the control group is rural area); *strata3*, *strata4* and *strata6* are each equal to 1 if the person's economic strata falls into the national category of 3, 4 and 6, respectively. Strata is a proxy variable for the classification of income levels (in the survey, there are no people living in strata 5). Strata 1 and 2 are used as the control group as they account for the lowest levels of personal income. The greater the strata category is, the largest the individual's income is expected. The variable *work* is also a dummy variable that equals 1 if the person has a job.

As noted in the literature, there is a need for further analyses on the potential heterogeneity of sustainable behaviors around people's educational levels. Analysis of this kind allows us to identify the most suitable educational strategies to boost people's pro environmental actions according to their socio demographic characteristics. The estimated coefficients $\hat{\gamma}_h$ in Eq. (3) are used to examine whether the hypothesized increase in people's sustainable behaviors from additional schooling levels differs between individuals based on their socioeconomic characteristics, including age, living location, among other factors.

$$\begin{aligned}
z = & \beta_0 + \beta_1 technical + \beta_2 undergr + \beta_3 postgr + \sum_j \beta_j x_j + \sum_h \gamma_h technical \cdot x_j \\
& + \sum_h \gamma_h undergr \cdot x_j + \sum_h \gamma_h postgr \cdot x_j + u_j
\end{aligned} \tag{3}$$

To analyze the sign and magnitude of changes in the ordinal dependent variable from discrete changes in the covariates included in this paper, we estimate marginal effects for discrete variables. Mathematically, marginal effects are represented as follows (Hill et al., 2011):

$$\begin{aligned}
\partial Pi(z = 1) / \partial x &= -\Phi(\kappa_1 - B'x) \\
\partial Pi(z = 2) / \partial x &= -\Phi(\kappa_2 - B'x)B + \Phi(\kappa_1 - B'x)B \\
\partial Pi(z = 3) / \partial x &= -\Phi(\kappa_3 - B'x)B + \Phi(\kappa_2 - B'x)B \\
\partial Pi(z = 4) / \partial x &= -\Phi(\kappa_3 - B'x)B
\end{aligned} \tag{4}$$

The ordered probit regression has a limitation, which is to assume the presence of parallel regressions (UCLA, n.d.); this is, it assumes that the effect of changes in covariates on the response variable is assumed to be the same for each accumulated probit (there is a common slope of estimated betas). After using the approximate likelihood ratio test, this hypothesis is not rejected at any conventional level of significance ($Prob > chi2 = 0.2412$), suggesting that estimates from the ordinal probit model in this paper are more consistent than estimates from the nominal probit model. Estimates from the ordinal probit model in this paper include standard errors corrected by urban-rural clusters (Stata, n.d.). The correction of standard errors is important, not just to reduce the loss of efficiency, but also to avoid biased estimates from the ordered probit/logit regressions (Williams, 2008). Analysis of tetrachoric correlations show no signs of high correlations between binary variables (assuming a normal distribution), and the Variance Inflation Factor test shows no presence of perfect or quasi-perfect multicollinearity between explanatory factors.

Empirical Results

The estimated results from the ordinal probit model that include scores of sustainable behaviors from the people of Sabaneta are reported in Table 3. Analyses of these results are presented in two analytical parts. Part A shows the marginal effects of changes in socio-economic variables on people's sustainable behaviors as described in Eq. (2). The estimated coefficients of *technical*, *undergr*, and *postgr* are key in this paper to examine whether growth in the levels of education of people from Sabaneta are associated with increases in people's sustainable behaviors. Part B shows the estimated results of Eq. (3), which allow us to identify whether there are heterogeneous sustainable behaviors around people's levels of education that can be explained by people's socioeconomic characteristics, including age and residents' location of residence.

Socioeconomic Characteristics that Influence on Sustainable Behaviors

Key results associated with schooling levels in Table 3, Part A, show that the probability of adopting very high sustainable behaviors increases as attained levels of schooling increase. Marginal effects in column (i) show that the probability of having very high sustainable behaviors is 6.4 percentage points (pp) greater in people that hold undergraduate studies compared to people with primary/secondary studies or no studies (the control group), and 11.8 pp greater in people with postgraduate studies compared to people in the control group. Residents who have technical/technological studies tend to have less probabilities of having very high sustainable behaviors compared to residents in the control group (-1.18 pp less). Surprisingly, the probability of high sustainable behaviors in column (ii) is -0.3 pp less in people that hold undergraduate studies compared to people in the control group, and -1.4 pp less in people with postgraduate studies compared to people in the control group (see column (ii) in Table 3).

Table 3. Ordered Probit Model of Sustainable Behaviors

<i>Dependent variable: Sustainable behaviors</i>				
<i>Independent Variables</i>	<i>very high (i)</i>	<i>high (ii)</i>	<i>medium (iii)</i>	<i>low (iv)</i>
<i>Part A</i>				
<i>technical</i>	-.0118*** (.0011)	-.0001 (.00012)	.0065*** (.00018)	.0053*** (.0008)
<i>undergr</i>	.0643*** (.0032)	-.0031** (.0015)	-.0352*** (.0010)	-.0259*** (.0027)
<i>postgr</i>	.1187*** (.0034)	-.0148*** (.0038)	-.0630*** (.0037)	-.0409*** (.0033)
<i>age55</i>	0.0424*** (.0098)	-.0011*** (.00016)	-.0233*** (.0071)	-.0179*** (.0028)
<i>urban</i>	-.0263*** (.0018)	-.0004** (.0002)	.0146*** (.0000)	.0121*** (.0016)
<i>strata3</i>	.0378*** (.0059)	.0003 (.0005)	-.0210*** (.0048)	-.0172*** (.0016)
<i>strata4</i>	.0698*** (.0057)	-.0048*** (.0006)	-.0378*** (.0061)	-.0270*** (.0003)
<i>strata6</i>	-.2159*** (.023)	-.085*** (.0125)	.1066*** (.0110)	.1944*** (.0245)
<i>male</i>	-.0474 (.0527)	-.0002 (.0011)	.0262 (.0312)	.0213 (.0225)
<i>work</i>	-.0323 (.0403)	-.00028 (.0011)	.0179 (.0237)	.0147 (.0177)
<i>Part B</i>				
<i>technicalage55</i>	-.1231*** (.0348)	-.0281*** (.0098)	.0674*** (.0148)	.0837*** (.0297)
<i>undergrage55</i>	.0659 (.1398)	-.0165 (.0205)	-.0334 (.0749)	-.0160 (.0444)
<i>postgrage55</i>	-.1642*** (.0332)	.0040 (.0057)	.0871*** (.0091)	.0731*** (.0183)
<i>technicalurban</i>	-.0505*** (.0064)	-.0018 (.0014)	.0281*** (.0014)	.0243*** (.0035)
<i>undergrurban</i>	-.0511*** (.0173)	.0047 (.0033)	.0276*** (.0069)	.0187*** (.0071)
<i>postgrurban</i>	-.1277** (.0535)	.0203 (.0135)	.0667*** (.0212)	.0406** (.0186)
<i>Observations</i>	415	415	415	415

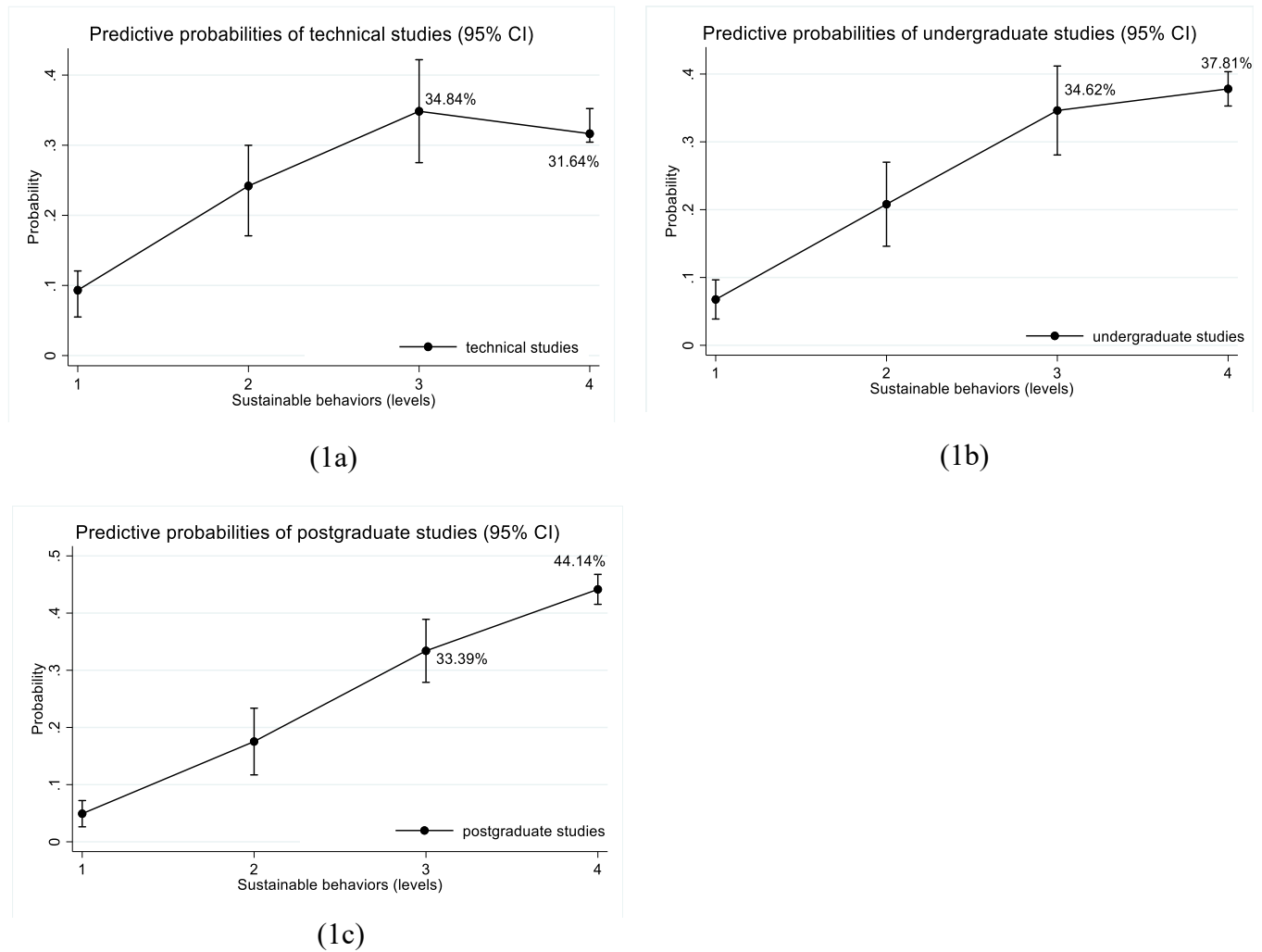
Note 1: ***, **, and * indicate whether the coefficient is significant at the 1%, 5%, and 10%, respectively
Delta method standard errors are in parenthesis
The estimated coefficients are marginal effects

Columns (iii) and (iv) in Part A show, as expected, that the probabilities of adopting medium and low sustainable behaviors by residents with postgraduate degrees are less than the probabilities of adopting medium and low sustainable behaviors by residents in the control group (-6.3 pp and -4.0 pp, respectively). A similar case is observed in people with undergraduate studies in columns (iii) and (iv), whose probabilities of showing medium and low sustainable behaviors are -3.5 pp and -2.5 pp below the same probabilities of the control group, respectively.

The previous results advocate the literature on sustainable behaviors that shows that people with more education have more civic skills to guide their activities towards caring for the environment (Lubell et al., 2007; Ogunbode & Arnold, 2012; Casaló et al. 2019). Education is one of the key reasons why people exhibit increasing sustainable behaviors as compared to people with less education (Martinsson & Lundqvist, 2010).

Figure 1 identifies predictive probabilities of people's sustainable behaviors by educational levels, considering the mean values of explanatory factors. Clearly, the most representative levels of sustainable behaviors of people with technical/technological studies in Sabaneta are high (level 3) and very high (level 4) with a mean accumulative probability of 66% (Figure (1a)). This percentage increases in people with undergraduate and postgraduate studies, whose cumulative probabilities of high and very high sustainable behaviors are 72% and 78%, respectively (see Figures (1b) and (1c)). As shown before in the analysis of marginal effects, the probability of adopting greater sustainable behaviors arises as people educate more.

Figure 1. Predictive Probabilities of Sustainable Behaviors by Educational Levels.



Source: own elaboration based on estimated results

Findings for the variable *age55*, column (i) in Part A, show that people over 55 years of age register a probability of adopting very high sustainable behaviors greater in 4.2 pp than the probability of having very high sustainable behaviors by people under 55 years of age (the control group). Notwithstanding, columns (ii), (iii) and (iv), show less probabilities of adopting high, medium, and low sustainable behaviors by people over 55 compared to the probabilities of the control group (-1.1 pp, -2.3 pp, and -1.7 pp, respectively). Additional statistical analyses (not

reported here) show that the cumulative predictive probabilities of adopting very high and high sustainable behaviors by people over 55 and under 55 years of age are 70.6% and 66% respectively, suggesting that the average elderly person tends to show more friendly actions with the environment than his/her younger counterparts. These findings go in line with the study by Pearson, Casey & Scott (2006), although differ from the studies by Martinsson & Lundqvist (2010) and Chen et al., (2011); the latter authors show younger people to adopt environmentally sustainable behaviors more frequently.

The results for the factor *urban* in Part A show that people in the urban area of Sabaneta tend to carry out less sustainable behaviors compared to people in the rural area. The probabilities of adopting very high and high sustainable behaviors by residents in urban areas (see columns (i) and (ii)) are below the probabilities of adopting very high and high sustainable behaviors of residents in rural areas by 2.6 pp and 0.04 pp, respectively. The results are statistically significant at the 1% and 5% levels, respectively. Predictive probabilities show that the highest probabilities of sustainable behaviors in both population groups (urban and rural residents) lie on very high levels (30% and 33%, respectively) and high levels (35% and 35%, respectively). This result differs from the study by Martinsson & Lundqvist (2010), who found that people in urbanized areas present better environmental behaviors than those in rural or less urbanized areas.

The *urban* estimated coefficient above suggests that people from the rural area of Sabaneta are slightly more aware of their environment-associated actions than people from the urban area. This can be explained, first, by rural residents' proximity to important strategic ecosystems and protected areas in the municipality's jurisdiction; second, by the rural residents' greater familiarity of the work on protection and conservation established by the municipality in the Local System of Protected Areas (Agreement 30/2018); and third, by a greater absorption of

climate-change associated information by rural residents – information released within the framework of environmental education established in the Agreement 30 mentioned earlier.

Results for *strata* variables show that people' sustainable behaviors decrease as socioeconomic strata increases. In column (i), Part A, the probabilities that people living in strata 3 and strata 4 adopt very high and high sustainable behaviors are 3.7 pp and 6.9 pp greater than the probabilities of adopting the same sustainable behaviors by people living in strata 1 and 2 (the control group). Conversely, people who live in strata 6 show -21 pp less probability of having very high sustainable behaviors compared to the same control group. In columns (iii) and (iv), individuals from strata 6 show 10.6 pp and 19.4 pp more probabilities of adopting medium and low sustainable behaviors than people in the control group. This result differs from the studies by Scott & Willits (1994), Franzen & Meyer (2010) and Martinsson & Lundqvist (2010), in which people with greater income levels (proxied in this paper by socioeconomic strata levels) are found to have higher ecological attitudes compared to people with less purchasing power.

Findings for *male* and *work* in Part A, show no statistically significant differences between male and female residents, and between workers and no workers of Sabaneta regarding their probability levels of sustainable behaviors (see columns (i) and (ii)). However, other statistically significant figures (not reported here) show that the cumulative predictive probabilities of adopting very high and high sustainable behaviors by male and female residents are 65% and 69%, respectively; a result that slightly points out women as more proactive with the environment compared to men. Also, cumulative predictive probabilities show that people who work tend to be slightly less environment-driven than people who do not work, as their cumulative predicted probabilities of very high and high sustainable behaviors of these two groups stand on 66% and 68%, respectively.

Sources of Heterogeneity Around Education Effects

This second part of analysis explores the potential sources of heterogeneity between people from Sabaneta around the mean effects of educational levels on sustainable behaviors (columns (i) to (iv) of Table 3, part B). Results takes into account heterogeneous sustainable behaviors around education that can be explained by statistically significant socioeconomic factors, including residents' age (*age55*) and residents' area of residence (*urban*).

The estimated results of *technicalage55*, *undergrage55* and *postgrage55* show that the probability of having increasing sustainable behaviors from additional levels of education differ between people older than 55 and younger people (the control group). Statistically significant results in column (i) show that the probabilities of adopting very high sustainable behaviors by residents over 55 years of age with technical/technological studies and postgraduate studies is 12.3 pp and 16.4 pp less than the probability of adopting very high sustainable behaviors by younger people with technical/technological studies and postgraduate studies. In paralell, results in columns (iii) and (iv) show that the probability of adopting medium and low sustainable behaviors by 55-year-old people with technical/technological studies and postgraduate studies is between 6.7 pp and 8.7 pp greater than the probability of adopting medium and low sustainable behaviors by younger people (the control group) with the same study levels.

Previous results in Part A showed that people with more education tend to have greater sustainable behaviors than people with less educational levels, and that elderly people tend to have slightly higher environmentally friendly actions than their younger counterparts. The new outcome using the interaction variable model implies that, when comparing people with the same levels of education, those who are less than 55 years old tend to be more pro environment than those over 55 years of age. Therefore, education is an strategic factor to guide people from Sabaneta to adopt greater sustainable behaviors at different life stages.

Finally, findings for *technicalurban*, *undergrurban* and *postgrurban* coefficients show that the probability of increasing sustainable behaviors from attained higher levels of educations differ between people from urban and rural areas. The coefficients in column (i), Part B, show that the probabilities of adopting very high sustainable behaviors by urban residents with technical/technological studies, undergraduate studies, or postgraduate studies is 5.0 pp, 5.1 pp, and 12.7 pp less than the probability of adopting very high sustainable behaviors by rural residents with technical/technological, undergraduate, or postgraduate studies, respectively. Results in columns (iii), Part B, mirrors this finding, and shows that the probability of seeing a urban-area located person with technical/technological studies, undergraduate studies, or postgraduate studies adopting medium sustainable behaviors is 2.8 pp, 2.7 pp, and 6.6 pp greater than the probability of adopting medium sustainable behaviors by a rural-area located resident (the control group) with the same study levels. Similarly, column (iv) shows that people from urban areas with technical/technological studies, undergraduate studies, or postgraduate studies are 2.4 pp, 1.8 pp, and 4.0 pp more likely to adopt low sustainable behaviors than people from rural areas with the same attained study levels, respectively. Thus, when comparing people from rural and urban areas with the same levels of education, those from rural areas tend to show more positive actions for the environment compared to people from urban areas.

Concluding Remarks

This paper analyses socioeconomic factors that influence on the sustainable behaviors of people from Sabaneta, Colombia, using the multinomial ordinal probit model. The study focuses on the role of educational levels on people's sustainable behaviors. Findings show, first, that the probability of adopting greater sustainable behaviors increases as people's levels of education

increase. This result can be generalized to other municipalities of Colombia (where education can play an important role within climate change agendas), and shows the importance of greater regional advances in education to build sustainable behaviors (linked to SDG 12 on responsible consumption and production).

The paper identifies, however, statistically significant sources of heterogeneity between people from Sabaneta around educational levels. Results suggest that education should be primarily promoted in early life cycle stages as people under 55 years of age with more educational levels show greater sustainable behaviors than people over 55 with the same levels of education. The results also imply further efforts to promote increasing sustainable behaviors in people from urban areas as they study more. More years and levels of education should guarantee a reduction in existing gaps of sustainable behaviors between urban and rural populations.

It is key to build further policy initiatives aimed at strengthening educational and environmental public policies that promote environmental care. These initiatives should be guided by the need of healthier and more sustainable environments for current and future generations in Sabaneta; initiatives that ultimately contribute to the achievement of SDGs associated with climate change, including SDG 12. Based on these results, it is recommended that public policy makers at the national and municipal levels strive for the development and execution of strategies aimed at raising people's years of schooling, considering residents' sociodemographic differences between them (mainly associated with people's age and places of residence). Policies focused on more years of education are expected to increase the culture of care for the environment in the youngest.

The design of educational strategies aimed at raising awareness and sensitizing the population living in urban areas about the importance of caring for and conserving the environment is also recommended. It is necessary to make it clear that this is not an issue alien to

the lifestyle of the inhabitants, since it is a shared responsibility between people that has a strong impact on the environment that surrounds them.

Finally, there are some limitations identified in this study. The first one is the inability to add further socioeconomic variables, already included in the literature, that could potentially explain people's sustainable behaviors such as the costs of adopting sustainable actions, residents' marital status, among other factors. An statistical limitation is the absence of expansion factors in the survey utilized in this study, which could potentially provide greater unbiasedness and efficiency of estimated coefficients. Another limitation is the desirability bias, since many residents could have responded guided by the interviewer's listening interests, or by their own beliefs on what is socially acceptable. For this reason, it is recommended in future studies to include a test that measures the social desirability bias of respondents, and to add complementary qualitative methodologies aimed at analyzing personal stories.

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