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ABSTRACT

This study looks at pro-environmental behaviors (PEBs) for waste reduction in Ecuador's heavily populated Guayas area. The research, which focuses on green consumer, recycler, and waste-preventer behaviors, applying an Extended Theory of Planned Behavior (TPB) to investigate the influence of attitudes, subjective norms, and perceived behavioral control on people's intentions to behave environmentally and uses external influences as moderating role variable. This research intends to contribute to targeted treatments and strategies promoting sustainable behaviors and environmental consciousness by better understanding the factors that drive waste reduction PEBs. A total of 3805 people were polled, and confirmatory analysis and structural equation modeling was utilized to review the data. The study finds that attitudes, perceived behavioral control, and subjective norms significantly influence citizens' intentions to engage in green consumer and waste-preventer behaviors. However, the intention to behave ecologically does not significantly affect recycler behavior. External influences also moderate the relationship between intentions and all three-waste reduction pro-environmental behaviors. This investigation illuminates the psychological dimensions underlying the observed variability in pro-environmental waste reduction behaviors among residents in a metropolitan area situated in South America, specifically within a developing world context. Finally, the study emphasizes the importance of addressing citizens' attitudes and norms to promote green consumerism, waste prevention, and recycling. Limitations include self-report bias and demographic bias. Future research should expand to include other regions and countries.

1. Introduction

In recent times, environmental sustainability has become an increasingly pressing global issue. The rapid urbanization and escalating consumption rates in developing countries, fueled by technological advancements and globalization, have fostered unsustainable consumption patterns. As a result, the ecosystem is experiencing irreparable damage, including soil, water, and air pollution, as well as biodiversity loss in flora and wildlife. Governments, businesses, and individual consumers alike are now grappling with these urgent environmental concerns (Kiatkawsin and Han, 2017).

The current literature identifies human activities as the primary driver of resource abuse, environmental pollution, global warming, and biodiversity loss (Albayrak et al., 2013; Arisal and Atalar, 2016). Observations indicate that every form of consumption exhausts valuable resources, and consumer behaviors, especially in terms of utilization and disposal, exert a direct influence on natural resources (Vermeir and Verbeke, 2006). Every possible attempt to preserve the environment is undermined by the exorbitant demands of millions of users.

Establishing a balanced and enduring association between the human populace and the natural environment necessitates a transformation in human behaviors, given that human actions constitute the fundamental cause of numerous environmental challenges (Vlek and Steg, 2007). As a result, many experts believe that raising environmental awareness is the most effective way to reduce the detrimental influence of humans on the environment (Barbarossa and De Pelsmacker, 2014; Nguyen et al., 2017; Kautish and Sharma, 2019).

Recent research has referred to human activities that safeguard the environment as "pro-environmental behaviors," "green behaviors," "environment-friendly behaviors," or "low-carbon behaviors" (Fu et al.,

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2017; Koger and Winter 2011). PEBs include measures that try to reduce environmental harm or perhaps improve it. These endeavors encompass initiatives aimed at shielding the natural environment from the adverse impacts of human activities (Stern, 2000). More recently, there has been a significant focus on reducing landfill waste through the promotion of waste-reduction environmental behaviors such as waste prevention, recycling, and green consumption.

Motivation, attitude, and environmental concern have all been thoroughly researched as significant drivers of people's waste separation practices in industrialized nations (Choi et al., 2015). Values, religion, and social norms have all been recognized as motivators for green buying PEBs. In addition, augmenting the general population perception of the negative impacts that waste can have on the natural environment can lead to encourage them to waste recycling behaviors (GARCÉS et al., 2002).

While different formal (laws and regulations) and informal (curbside waste picking) actions can affect the effectiveness of the waste management systems, without proper social engagement, the success rates of these initiatives can be undermined. Thus, the present research contributes to academia by using the Theory of Planned Behavior (TPB) (Ajzen, 1991) to identify what are the main drivers to engage in household waste reduction activities in Ecuador. The main novelty points reside on the lack of theoretically based studies on the application of PEBs in the South American Region, the geographical location of the research, the applied theoretical framework, and the statistical tool used.

First, numerous environmental studies have focused on understanding the elements that influence people's pro-environmental behaviors, however, only a handful of studies have been focalized in the developing South America region and most specifically, have addressed the general population, and even fewer have touched the subject of waste reduction PEBs. In fact, a search using the Scopus and Web of Sciences databases revealed a total of 9629 and 9,126, respectively, using the key words: "PEB" OR "Pro-Environmental" OR "Pro-environmental" in the first search. When adding in the second search the keywords: "South-America" OR "LATAM", these values went down to 21 and 15, respectively, giving a total of 36. Once the duplicates were deleted, a total of 25 papers remained. After reading the abstracts, only three of them touched waste reduction PEBs in countries such as Chile (Bronfman et al., 2015), Colombia (Saza Quintero et al., 2020), and Peru (Méndez-Lazarte et al., 2023), and only the Chilean study addressed the general population of a major metropolis (Bronfman et al., 2015).

Second, as per findings from the Euromonitor Lifestyles survey, it is noteworthy that South America emerges as the region displaying the utmost apprehension regarding climate change and a robust inclination towards promoting beneficial environmental transformations (Araya and Zuniga, 2021). Notably, in 2008, Ecuador achieved a significant milestone in green political theory by becoming the first country worldwide to incorporate ecological thinking into its constitution (Ecuador, C. P. EC, 2008), and following this, in 2020, the Organic Law for the Rationalization, Reuse, and Reduction of Single-Use Plastics was released with the intention to regulate the generation of plastic waste through its responsible use and consumption (Hidalgo-Crespo et al., 2022). These groundbreaking moves reflect Ecuador's commitment to environmental protection and sustainability.

Third, the TPB framework is a popular and significant theoretical paradigm for understanding the consequences and impacts of different psychological traits and factors on pro-environmental conduct. It has been frequently used to investigate individuals' intentions and actions toward environmentally friendly behaviors, emphasizing the importance of attitudinal components in predicting and explaining behavior (Aguilar-Luzón et al., 2012; López-Mosquera and Sánchez, 2012). In fact, a Scopus navigation search indicated that as of 2023, this theory has been mentioned around 300 times to explain pro-environmental behaviors, more than twice the second most popular, the value-belief-norm hypothesis. TPB, which includes attitude towards behavior (ATTB), subjective norms (SUNO), and perceived behavioral control (PEBC), provides a core paradigm for investigating people's behaviors in relation to green products and services. It also enables for the analysis of contextual variables such as morality and external influences. As a result, TPB has become a basic cornerstone in the field of pro-environmental behavior, influencing countless studies and research (Carfora et al., 2017; Hsu et al., 2017; Kalafatis et al., 1999; Kumar et al., 2017).

Despite its popularity, very few studies have addressed general population of a city, such as homeowners or household heads. Abadi et al. (2021) employed a self-administered questionnaire for wholesalers and discovered that the three TPB constructs have a beneficial effect on behavioral intention to manage fruit and vegetable waste. Another study revealed moral standards and convenience as important factors motivating TPB constructs to impact household recycling intentions in Saudi Arabia (Soomro et al., 2022). Additional research demonstrated the utility of extending the TPB framework for the prediction of the willingness to avoid food waste generation and diminish its overgeneration by managing food utilization (Soorani and Ahmadvand, 2019). Furthermore, there exists a significant gap in our understanding of how external factors, such as penalties, incentives, and knowledge, may impact individuals' values, beliefs, and personal norms concerning environmental actions (Kinzig et al., 2013).

The fourth and last novelty point relates to the statistical tool applied to test the hypothesized model. The current analysis used a Partial Least Squares Structural Equation Modeling (PLS-SEM) that can cope with categorical indicators (Schuberth et al., 2016). This statistical tool is well tested and its use has rocketed in recent years (Hair et al., 2018; Sarstedt et al., 2022).

In summary, the objectives of the current paper are: 1) identify the main drivers of citizens' pro-environmental behaviors, specifically green consumer, recycler, and waste preventer; 2) prove the usefulness of the theory of planned behavior as a tool to explain the pro-environmental behaviors; 3) provide relevant information about the moderating role of external influences; and 4) extend the literature of PLS-SEM applications. Following, Section 2 will provide a full explanation of the methods employed in the study to create the conceptual framework and it will further explain the area of study and the data collection procedures. The validity and reliability tests together with the hypothesis validation on the framework will be presented in Section 3. The study's discussion, theoretical and practical implications together with its limitations will be noted in Section 4. Finally, Section 5 will conclude with a summary of the study's main points.

2. Materials and methods

2.1. Research model framework

Stern (2000) defines Pro-Environmental Behaviors (PEBs) as actions that have a positive impact on the availability of materials or energy, as well as behaviors that positively influence the structure and dynamics of ecosystems or the biosphere. In 2012, researchers analyzed 50 measurement items related to six types of PEBs, which included activist, avoider, green consumer, utility saver, recycler, and green passenger (Cleveland et al., 2012). However, based on previous studies focusing on waste minimization in homes, it was concluded that only green consumer and recycler follow this specific pattern. A novel type of Pro-Environmental Behavior called "Waste Preventer" was included in the study. The concept of waste avoidance is consistent with the European Commission's (EC, 2008) advice statement, which emphasizes that restricting needless consumption and picking items that generate less waste are effective ways for strictly avoiding waste. These three categories encompass individuals who aim to minimize their environmental impact when acquiring products, adhering to the principles of the 3Rs: reduce, reuse, and recycle.

Following, the three PEB constructs considered are briefly described:

- Green Consumer: They are characterized as people who practice a range of green behaviors primarily for environmental concerns (Barbarossa and De Pelsmacker, 2014). This category includes those who are aware of sustainable development and sincerely care about environmental preservation (Cleveland et al., 2012). They are more likely to be innovative users of existing physical resources, looking for novel reuses and numerous applications for their products (Paço et al., 2019). People's strong moral convictions and desire to have a good impact on the environment drive them to actively seek and choose environmentally friendly products and services (Lee et al., 2014). The potential benefits to both the environment and society are the driving motivator for engaging in this action.
- Recycler: Individuals in the Recycler group actively participate in efforts to handle recycled or recyclable materials (Lee et al., 2014). It entails actively participating in recycling programs, separating recyclable materials from general waste, and ensuring that these materials are processed and reused in an environmentally responsible manner.
- Waste Preventer: Individuals in the Waste Preventer group actively take steps to reduce trash by consuming less and choosing items that generate less garbage. This goes beyond simply being a green consumer because it involves a personal cost or sacrifice and has a more direct impact on environmental protection and preservation. Tonglet et al. (2004) describe waste prevention as practices such as carefully selecting new items and emphasizing repair and reuse over replacement at the end of a product's life cycle.

2.1.1. Theory of planned behavior

According to the Theory of Planned Behavior, an individual's predisposition to engage in a specific action, such as green shopping, is strongly tied to their desire to do so (Fishbein, 2002). TPB provides a conceptual framework for studying how attitudes, subjective norms, and perceived behavioral control affect behavior (Ajzen, 1991). TPB emphasizes the role of personal thoughts and perceived advantages in motivating purposeful action. According to Han et al. (2010), TPB enables researchers to understand population's behavioral intentions by assessing different attributes of their personal lives, their interactions with their social environment, and how external factors may influence them, which is particularly relevant for examining intentions to buy green products (Jebarajakirthy et al., 2014). This is because TPB evaluates each component with equivalent specificity, facilitating the link between intention and its underlying determinants. Attitudes in the context of TPB indicate an individual's psychological stance toward a desirable or undesirable matter, which influences their willingness to participate in acts such as waste separation and recycling. Subjective norms are shaped by social referents such as family, friends, neighbors, and coworkers, as well as the influence of political and media organizations, which may exert peer pressure or support for a specific behavior (Tonglet et al., 2004). Furthermore, the TPB definition of perceived behavioral control predicts both intention and behavior. It expresses a person's view that he or she has the ability and opportunity to carry out the behavior efficiently (Ajzen, 2002). In conclusion, TPB affirms that every individual engagement to green or pro-environment behaviors is dependent on their perception of the benefits such activities will produce, on how the people they respect and admire support these green activities and in their perception of their ability to get enough resources and their power to perform such tasks effectively. TPB examines these constructs to gain valuable insights into individuals' behavioral intentions and the factors influencing their decision-making.

2.1.1.1. Intentions to behave ecologically. Behavioral intentions represent an individual's commitment to taking action and are influenced by a combination of factors (Fishbein, 2002). They explain the important roles of both excitement and endeavor to push people to perform a specific pro-environmental habit. Ajzen (1991) suggested that there exists a strong correlation between an individual's intentions to perform a behavior and that they actually execute them.

Behavioral intentions show an individual's willingness to take action and are impacted by a variety of conditions (Fishbein, 2002). They demonstrate how much drive and effort people are willing to put forth to perform a particular habit. According to Ajzen (1991), greater intentions are more likely to be carried out. It is critical in the study of environmental psychology to investigate the relationship between green behavioral intentions and subsequent green behavior. Kaiser et al. (1999) found that ecological behavior intentions predict overall ecological behavior. Furthermore, some researchers have discovered favorable relationships between the intention to acquire organic products and the actual purchase of organic items (Tarkiainen and Sundqvist, 2005; Nguyen et al., 2016; Kumar et al., 2017). We propose the following hypothesis based on our findings:

H1. Intention to behave ecologically has a positive effect on citizens' recycler behavior.

H2. Intention to behave ecologically has a positive effect on citizens' green consumer behavior.

H3. Intention to behave ecologically has a positive effect on citizens' waste-preventer behavior.

2.1.1.2. Attitude toward behavior. A person's attitude toward behavior shows their overall judgment and evaluation of a specific activity or behavioral goal. It includes their knowledge, attitudes, and biases, both good and negative, that influence how they perceive conduct (Ajzen, 1991). It tells whether the individual considers the conduct to be good or undesirable. Committing to perform environmentally friendly activities or make greener decisions is very dependable on individuals' positive attitude towards their surrounding environment. Numerous studies in the field of green products and energy-saving behavior have found a positive relationship between attitude and behavioral intention in a variety of cultural contexts. Consumer mindset, according to Zaremohzzabieh et al. (2021), influences green buying intention. Similarly, Paul et al. (2016) discovered that customer attitudes have a significant influence on the chance of purchasing green items. Wang et al. (2022) also verified that attitude toward green businesses serves as a partial mediator in the relationship between green brand positioning, green customer value, and green purchase intention. Wang et al. (2023) found that attitudes present a direct contribution on energy-saving behavior. Based on our review of the literature, we posit that a shift in attitudes about green business models will influence customers' willingness to embrace such models. Hence, we propose the following hypotheses:

H4. Attitude toward behavior has a positive effect on citizens' intention to behave ecologically.

H5. Attitude toward behavior has a positive effect on citizens' recycler behavior.

H6. Attitude toward behavior has a positive effect on citizens' green consumer behavior.

H7. Attitude toward behavior has a positive effect on citizens' waste-preventer behavior.

2.1.1.3. Perceived behavioral control. Ajzen (1991) defined perceived behavioral control as an individual's assessment of the ease or difficulty involved with performing a specific behavior, as well as their sense of personal control over its execution. When a behavior is viewed as easy to perform, it is said to have high perceived behavioral control, whereas a challenging behavior is said to have low perceived behavioral control. This idea is related to the concept of self-efficacy, which refers to a person's confidence in their ability to do an activity. Self-efficacy is influenced by an individual's judgment of internal aspects such as ability

and determination, as well as external ones such as resource availability and support. Research findings consistently support the importance of perceived behavioral control in predicting intentions and behaviors, particularly for actions over which an individual has limited control, such as green product purchases (Ruangkanjanases et al., 2020; Karatu and Nik Mat, 2015; Wijayaningtyas et al., 2019). We propose the following theories based on these findings:

H8. Perceived behavioral control has a positive effect on citizens' intention to behave ecologically.

H9. Perceived behavioral control has a positive effect on citizens' recycler behavior.

H10. Perceived behavioral control has a positive effect on citizens' green consumer behavior.

H11. Perceived behavioral control has a positive effect on citizens' waste-preventer behavior.

2.1.1.4. Subjective norms. Subjective norms represent the impact of important individuals, such as colleagues, supervisors, friends, and family, on an individual's behavior and their beliefs about whether others are engaging in the same behavior (Ajzen, 1991, as cited in Han et al., 2010). This particular psychological construct explains the perceptions and affections that social and peer pressure can have on different individuals and if they indeed affect their decision to behave in different sustainable ways. If costumers perceive that their close social environment commence to embrace different greener behaviors, they might unknowingly develop an interest to mimic such behaviors and their intentions may change following the collective behavior (Wu and Chen, 2014; Li et al., 2023; Mostaghel and Chirumalla, 2021; Csutora et al., 2022). Therefore, we propose the following hypotheses:

H12. Perceived behavioral control has a positive effect on citizens' intention to behave ecologically.

H13. Perceived behavioral control has a positive effect on citizens' recycler behavior.

H14. Perceived behavioral control has a positive effect on citizens' green consumer behavior.

H15. Perceived behavioral control has a positive effect on citizens' waste-preventer behavior.

2.1.2. The moderating role of external influences

Moderation means that the inclusion of a third party in the relationship amongst two variables changes to better or worse. This inclusion is known as a moderator variable. The presence of moderation means that the strength or direction of the relationship between the two constructs changes based on the different levels of the moderator variable.

Individuals' ethical views and mind processes to perform decisions are greatly influenced by external influences and their own internal beliefs (Cottone and Claus, 2000). External influences encompass a broad spectrum of social factors, including situational circumstances, interconnected occurrences, and external viewpoints, such as the expectations of stakeholders, national legal regulations, societal norms, collective agreement, as well as the individual or collective repercussions. Interactions with external variables shape people's perceptions, feelings, and attitudes on a variety of topics. The level of approval displayed by others toward the same activities influences people's acceptance of those behaviors. Observational learning plays a role, as individuals often imitate behaviors when unsure about the appropriate course of action, making their behaviors subject to social pressure.

The goal of this research is to investigate whether external influences moderate the relationship between intentions to behave ecologically and the different pro-environmental behaviors.

H16. External Influences moderate the relationship between the Intention to Behave Ecologically and Recycler behavior.

H17. External Influences moderate the relationship between the Intention to Behave Ecologically and Recycler behavior.

H18. External Influences moderate the relationship between the Intention to Behave Ecologically and Waste-Preventer behavior.

Based on the aforementioned literature review, the following is our research model (Fig. 1).

2.2. Data collection framework

2.2.1. Sample target

This research centered on the Guayas province, the most densely populated province among the 24 in Ecuador. It is located in the southwest of the country and has a population of about 4.5 million people, accounting for 24.5% of the total. Furthermore, Guayas is Ecuador's major commercial, economic, and industrial center. The province's four main cities were studied: Guayaquil, Samborondon, Daule, and Durán. These four cities have a combined population of 3.03 million people, which accounts for 67.33% of the entire Guayas province. In 2020, Guayaquil (the province's largest city) produced 4000 tons of municipal solid waste (MSW) each day, with an average per capita output of 1.47 kg for its 2.7 million citizens. Household solid waste accounted for over 40% of total garbage, or 0.58 kg per day per capita. The HSW composition was roughly 70% biowaste and 24% traditional recyclable materials (Hidalgo-Crespo et al., 2021). Despite these figures, less than 4% of all MSW was sorted and recycled. The majority of the debris wound up in the local landfill known as "Las Iguanas," which poses a risk of soil and groundwater contamination. The situation is further compounded by the fact that in August 2020, around one thousand tons of plastic waste were exported from the United States to Ecuador, exacerbating the challenges faced by the city's municipal waste management handlers (Hidalgo-Crespo et al., 2023).

The ideal sample for this research comprises family heads aged 18 or older, who have the authority to make decisions over the three proposed pro-environmental behaviors for their respective homes in a circular manner (Bookwalter et al., 2006). Data collection took place between July and August 2022, using a combination of personal interviews and printed questionnaires (See Supplemental Information). Conducting in-person interviews allowed respondents ample time to reflect on their answers, and interviewers were available to address any uncertainties, reducing the likelihood of incomplete or non-responses (Kinnear and Taylor, 1996; Sekaran, 2000).

Different students (390 in total) from two of the biggest and most important (ranking position wise) universities of the city of Guayaquil took part in the data collection process. Initially, the project and its objectives were introduced to the participants. Subsequently, each interested student enlisted 10 households to confirm their willingness to participate. Following this, the registered students received training on the survey concepts. Finally, each student interviewed the head of the 10 registered households using an online questionnaire with Geographical Information System (GIS) features. Every interviewed individual signed an informed consent authorizing the use of the information for research purposes only and they were reassured of their anonymity in the use of the data.

Before the final data collection, the questionnaire underwent validation through 20 pre-tests. Twenty respondents were randomly selected to provide feedback, which helped us identify any critical questions or discrepancies that needed clarification or reformulation. The questionnaire was meticulously checked for potential weaknesses, misspellings, or leading questions, and appropriate adjustments were made accordingly.

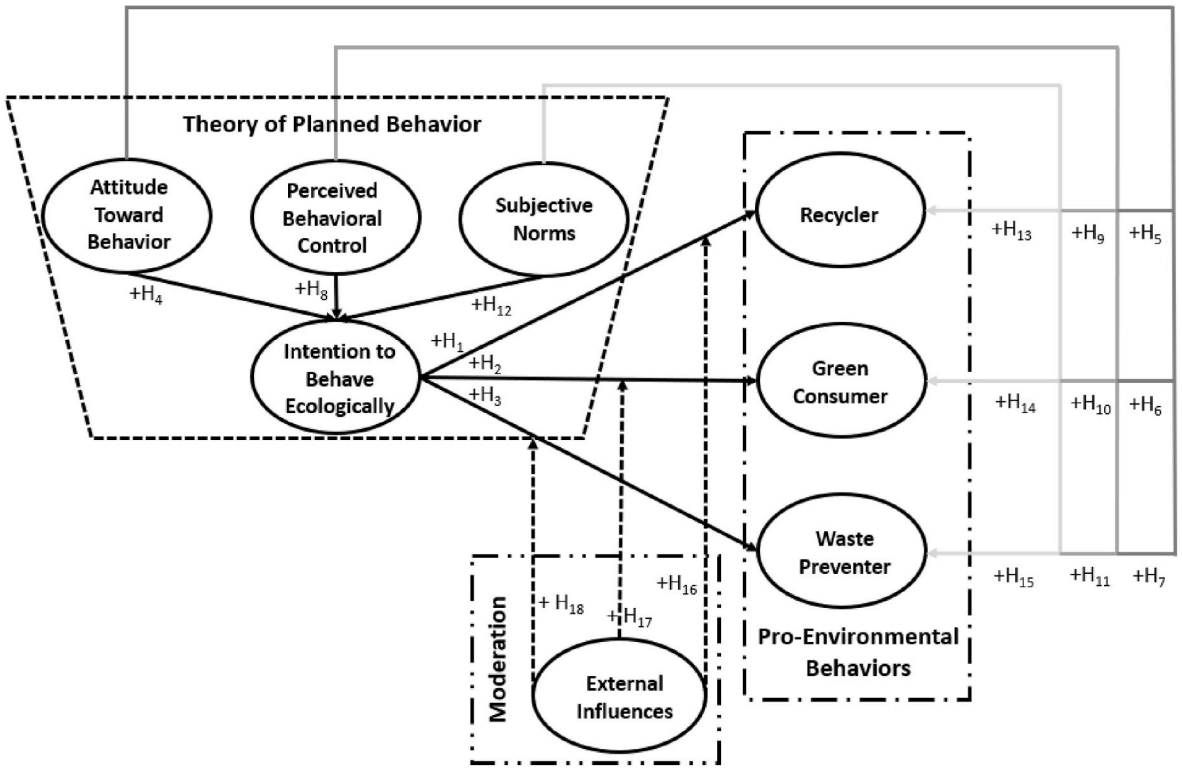

Fig. 1. Proposed research framework.

2.2.2. Sample size and composition

The sample size for this study was estimated using Hair et al. (2019)'s recommendation of 15–20 observations per studied variable. The current study contains eight constructs, with three items each for attitude toward behavior, perceived behavioral control, and subjective norms, four items for intentions to behave, five items for recycler behavior, eight items for external influences, nine items for waste preventer behavior, and twelve items for green consumer behavior. This yielded an appropriate sample size of 940 responders (47 × 20). However, the study utilized a considerable sample of 3805 responses, surpassing the recommended minimum value of 384 for infinite populations (Kwak and Kim, 2017). This ensures a 95% confidence level and a 5% margin of error.

According to the descriptive statistics in Table 1, the majority of respondents in the sample are male, between the ages of 37 and 58, have a bachelor's degree, have a family size of four, and earn less than 420 USD per month.

2.2.3. Measures

The study utilized validated measurement scales from previous research, employing a 5-point Likert scale to assess all eight constructs (Joshi et al., 2015). Attitude toward behavior and subjective norm were measured with 5 items, and perceived behavioral control was measured with 6 items, while intention to behave ecologically was assessed using eleven items, adapted from various sources (Fishbein and Ajzen, 1977; Taylor and Todd, 1995; Tu and Hu, 2018; Yuriev et al., 2020). Green consumer behavior was measured with 12 items, Recycler behavior with 5 items, and Waste preventer behavior with 9 items, drawing from (Tonglet et al., 2004; Cleveland et al., 2012). Finally, eight items were used to assess the external influences (Clark et al., 2003; Tu and Hu, 2018).

Table 1
Sample characteristics.

Variable	Categories	Frequency	Percentage[a]
Gender	Male	2541	66.78
	Female	1264	33.22
Family Size	1	127	3.34
	2	452	11.88
	3	885	23.26
	4	1058	27.81
	5	773	20.32
	6	305	8.02
	>6	205	5.39
Age of household head	18–25	297	7.81
	26–36	704	18.50
	37–47	1126	29.59
	48–58	1124	29.54
	59–69	436	11.46
	>69	118	3.10
Education of household head	None	61	1.60
	Primary School	359	9.43
	High School	1701	44.70
	Bachelor	1488	39.11
	Post-Graduate	196	5.15
Income of household head	None	151	3.97
	<420	1689	44.39
	421–840	986	25.91
	841–1260	642	16.87
	1261–1680	183	4.81
	1681–2100	74	1.94
	>2100	80	2.10

Note.
[a] The percentages presented in the analysis are calculated from a total usable sample of 3805 respondents.

3. Results

The acquired data was evaluated using SmartPLS 4.2 and the partial least squares structural equation modeling (PLS-SEM) approach. PLS-SEM is well-known for producing solid results in the field of environmental psychology, as evidenced by prior studies (Wang et al., 2019; Li et al., 2020; Ayob et al., 2017). One advantage of PLS-SEM is its non-parametric nature, which allows it to successfully deal with hidden

dimensions that are not readily visible. Furthermore, PLS-SEM requires less data for residual distributions, measurement scales, and sample sizes, making it ideal for use with SmartPLS-SEM (Hair et al., 2019). Its adaptability enables it to handle complex research models that include pertinent ideas and actual data.

3.1. Measurement model

Before evaluating the construct validity and reliability of the PLS-SEM measurement model, it was necessary to study the indicators' convergent and discriminant validity. Convergent validity and composite reliability were utilized to determine the correlations between indicators within each construct. As seen in Table 2, the majority of the items in each construct had factor loadings equal to or greater than the 0.5 threshold (between 0.610 and 0.892). Values below the threshold were deleted and are represented by an X in Table 2. Moreover, the Cronbach's alphas for all constructs surpassed the threshold value of 0.7, signifying robust internal consistency and reliability (between 0.840 and 0.955). Additionally, the composite reliability (CR) values for all constructs exceeded 0.7, affirming their reliability (between 0.854 and 0.958). Upon the constructs' initial formulation, the average variance extracted (AVE) exceeded 0.5, indicating satisfactory convergent validity (between 0.535 and 0.726).

A discriminant validity study was undertaken to confirm the distinctness of different notions, as indicated in Table 3 (Campbell and Fiske, 1959). Upon comparing the square root of Average Variance Extracted (AVE) values, which are represented on the diagonal of Table 3, with the correlations among the constructs within the proposed model (as per Fornell and Larcker, 1981), it was observed that the square root of AVE values (diagonal of Table 3) consistently exceeded those associated with the other variables. This outcome suggests the absence of a statistically significant correlation between the constructs. As a result, the results of this study passed the discriminant validity test.

3.2. Structural model assessment

After assessing the measurement model, the structural path was computed to evaluate path coefficients, examining the relationships between research constructs and determining their statistical significance.

H_1 assumed that there is a significant and affirmative affectation of the intention to behave ecologically significantly and the recycler behavior. The returns of the study exposed that the intention to behave ecologically doesn't have a significant and positive impact on the recycler behavior ($\beta = 0.031$, $p > 0.05$). Hence, H_1 was not supported.

H_2 assumed that there is a significant and affirmative affectation of the intention to behave ecologically significantly and the green consumer behavior. The returns of the study exposed that the intention to behave ecologically has a significant and positive impact on green consumer behavior ($\beta = 0153$, $p < 0.001$). Hence, H_2 was supported.

H_3 assumed that there is a significant and affirmative affectation of the intention to behave ecologically and the waste preventer behavior. The returns of the study exposed that the intention to behave ecologically has a significant and positive impact on the waste preventer behavior ($\beta = 0.208$, $p < 0.001$). Hence, H_3 was supported.

H_4 assumed that there is a significant and affirmative affectation of the attitude toward behavior and the intention to behave ecologically. The returns of the study exposed that attitude toward behavior has a significant and positive impact on the intention to behave ecologically ($\beta = 0.656$, $p < 0.001$). Hence, H_4 was supported.

H_5 assumed that there is a significant and affirmative affectation of the attitude toward behavior and the recycler behavior. The returns of the study exposed that attitude toward behavior has a significant and negative impact on the recycler behavior ($\beta = -0.189$, $p < 0.001$). Hence, H_5 was not supported.

H_6 assumed that there is a significant and affirmative affectation of the attitude toward behavior and the green consumer behavior. The returns of the study exposed that attitude toward behavior has a significant and positive impact on green consumer behavior ($\beta = 0.057$, $p < 0.050$). Hence, H_6 was supported.

H_7 assumed that there is a significant and affirmative affectation of the attitude toward behavior and the waste preventer behavior. The returns of the study exposed that attitude toward behavior has a significant and positive impact on the waste preventer behavior ($\beta = 0.146$, $p < 0.001$). Hence, H_7 was supported.

H_8 assumed that there is a significant and affirmative affectation of

Table 2
Reliability of scales.

Variable	Item	Outer loading	Cronbach's α	AVE	Composite Reliability
Attitude toward behavior (ATTB)	ATTB1	0.827	0.930	0.726	0.930
	ATTB2	0.841			
	ATTB3	0.892			
	ATTB4	0.847			
	ATTB5	0.852			
Perceived Behavioral Control (PEBC)	PEBC1	0.887	0.840	0.567	0.854
	PEBC2	0.806			
	PEBC3	0.677			
	PEBC4	0.610			
	PEBC5	X			
	PEBC6	X			
Subjective Norms (SUNO)	SUNO1	0.886	0.915	0.684	0.918
	SUNO2	0.860			
	SUNO3	0.800			
	SUNO4	0.836			
	SUNO5	0.746			
Intentions to Behave Ecologically (ITBE)	ITBE1	0.668	0.955	0.666	0.958
	ITBE2	0.765			
	ITBE3	0.820			
	ITBE4	0.833			
	ITBE5	0.812			
	ITBE6	0.828			
	ITBE7	0.845			
	ITBE8	0.833			
	ITBE9	0.839			
	ITBE10	0.862			
	ITBE11	0.853			
Recycler Behavior (RECY)	RECY1	0.873	0.890	0.618	0.894
	RECY2	0.711			
	RECY3	0.786			
	RECY4	0.731			
	RECY5	0.819			
Green Consumer Behavior (GRCO)	GRCO1	0.792	0.944	0.587	0.946
	GRCO2	0.786			
	GRCO3	0.828			
	GRCO4	0.751			
	GRCO5	0.784			
	GRCO6	0.794			
	GRCO7	0.811			
	GRCO8	0.662			
	GRCO9	0.751			
	GRCO10	0.730			
	GRCO11	0.735			
	GRCO12	0.760			
Waste Preventer Behavior (WAPR)	WAPR1	0.832	0.936	0.620	0.937
	WAPR2	0.760			
	WAPR3	0.787			
	WAPR4	0.787			
	WAPR5	0.835			
	WAPR6	0.809			
	WAPR7	0.797			
	WAPR8	0.676			
	WAPR9	0.792			
External Influences (EXIN)	EXIN1	0.668	0.902	0.535	0.901
	EXIN2	0.702			
	EXIN3	0.768			
	EXIN4	0.816			
	EXIN5	0.841			
	EXIN6	0.723			
	EXIN7	0.657			
	EXIN8	0.652			

Table 3
Reliability of scales.

Constructs	ATTB	EXIN	GRCO	ITBE	PEBC	RECY	SUNO	WAPR
Attitude Toward Behavior (ATTB)	0.852							
External Influences (EXIN)	0.632	**0.732**						
Green Consumer (GRCO)	0525	0.432	**0.766**					
Intention to Behave Ecologically (ITBE)	0.824	0.682	0.525	**0.816**				
Perceived Behavioral Control (PEBC)	0.759	0.589	0.585	0.716	**0.753**			
Recycler (RECY)	0.305	0.273	0.683	0.322	0.474	**0.786**		
Subjective Norm (SUNO)	0.672	0.519	0.536	0.649	0.740	0.465	**0.827**	
Waste Preventer (WAPR)	0.522	0.427	0.840	0.527	0.533	0.598	0.471	**0.787**

the perceived behavioral control significantly and the intention to behave ecologically. The returns of the study exposed that the perceived behavioral control has a significant and positive impact on the intention to behave ecologically ($\beta = 0.145$, $p < 0.001$). Hence, H_8 was supported.

H_9 assumed that there is a significant and affirmative affectation of the perceived behavioral control and the recycler behavior. The returns of the study exposed that perceived behavioral control has a significant and positive impact on the recycler behavior ($\beta = 0.372$, $p < 0.001$). Hence, H_9 was supported.

H_{10} assumed that there is a significant and affirmative affectation of the perceived behavioral control and the green consumer behavior. The returns of the study exposed that perceived behavioral control has a significant and positive impact on green consumer behavior ($\beta = 0.302$, $p < 0.050$). Hence, H_{10} was supported.

H_{11} assumed that there is a significant and affirmative affectation of the perceived behavioral control and the waste preventer behavior. The returns of the study exposed that perceived behavioral control has a significant and positive impact on the waste preventer behavior ($\beta = 0.236$, $p < 0.001$). Hence, H_{11} was supported.

H_{12} assumed that there is a significant and affirmative affectation of the subjective norms and the intention to behave ecologically. The returns of the study exposed that subjective norm have a significant and positive impact on the intention to behave ecologically ($\beta = 0.087$, $p < 0.050$). Hence, H_{12} was supported.

H_{13} assumed that there is a significant and affirmative affectation of the subjective norms and the recycler behavior. The returns of the study exposed that subjective norms have a significant and positive impact on the recycler behavior ($\beta = 0.245$, $p < 0.001$). Hence, H_{13} was supported.

H_{14} assumed that there is a significant and affirmative affectation of the subjective norms and the green consumer behavior. The returns of the study exposed that subjective norms have a significant and positive impact on green consumer behavior ($\beta = 0.107$, $p < 0.010$). Hence, H_{14} was supported.

H_{15} assumed that there is a significant and affirmative affectation of the subjective norms and the waste preventer behavior. The returns of the study exposed that subjective norms don't have a significant and positive impact on the waste preventer behavior ($\beta = 0.021$, $p > 0.050$). Hence, H_{15} was not supported.

The results are presented in Fig. 2 and Table 4.

3.2.1. Mediation analysis

In this study, mediation analysis was used to look into the potential mediating role of ITBE in the interaction between TPB constructs (ATTB, PEBC, and SUNO) and pro-environmental behaviors like recycler (RECY), green consumer (GRCO), and waste preventer (WAPR). The results (see Table 5) indicated a statistically significant indirect effect of

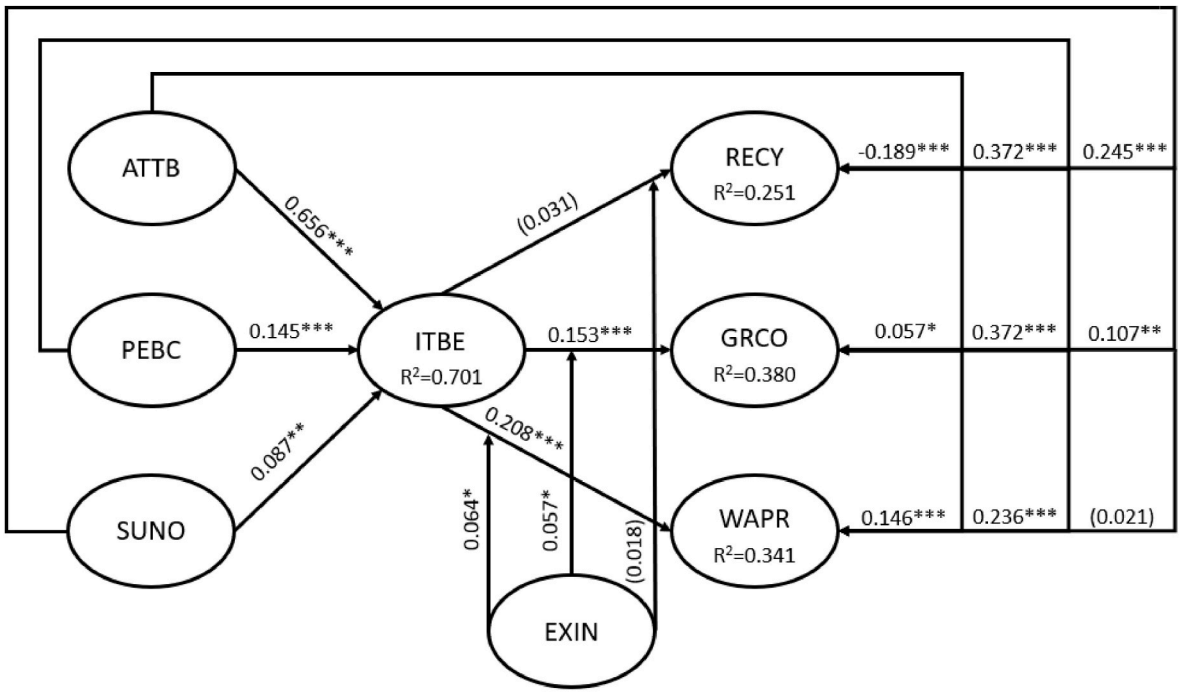

Fig. 2. Structural extended TPB model.

Table 4
SEM TPB model.

Hypotheses	β	SD	t-value	p-value	Results
H1: ITBE - > RECY	0.031	0.035	0.890	0.374	Not Supported
H2: ITBE - > GRCO	0.153	0.032	4.745	0.000[c]	Supported
H3: ITBE - > WAPR	0.208	0.035	5.958	0.000[c]	Supported
H4: ATTB - > ITBE	0.656	0.022	29.928	0.000[c]	Supported
H5: ATTB - > RECY	−0.189	0.038	4.986	0.000[c]	Not Supported
H6: ATTB - > GRCO	0.057	0.025	2.338	0.020[a]	Supported
H7: ATTB - > WAPR	0.146	0.036	4.045	0.000[c]	Supported
H8: PEBC - > ITBE	0.145	0.039	3.687	0.000[c]	Supported
H9: PEBC - > RECY	0.372	0.048	7.720	0.000[c]	Supported
H10: PEBC - > GRCO	0.302	0.043	6.994	0.000[c]	Supported
H11: PEBC - > WAPR	0.236	0.042	5.586	0.000[c]	Supported
H12: SUNO - > ITBE	0.087	0.035	2.504	0.012[a]	Supported
H13: SUNO - > RECY	0.245	0.039	6.374	0.000[c]	Supported
H14: SUNO - > GRCO	0.107	0.034	3.141	0.002[b]	Supported
H15: SUNO - > WAPR	0.021	0.035	0.606	0.545	Not Supported

Note. B = Beta Coefficient, SD = Standard Deviation, t-value = t – statistics, p-value = probability value. Relationships are significant at.
[a] $p < 0.05$.
[b] $p < 0.01$, and.
[c] $p < 0.001$. ATTB: Attitude toward behavior, PEBC: Perceived behavioral control, SUNO: Subjective norm, ITBE: Intention to behave ecologically, RECY: Recycler, GRCO: Green consumer, and WAPR: Waste preventer.

ATTB on GRCO ($\beta = 0.101$, $p < 0.001$) and WAPR ($\beta = 0.136$, $p < 0.001$); also, of PEBC on GRCO ($\beta = 0.022$, $p < 0.01$) and WAPR ($\beta = 0.030$, $p < 0.01$); and of SUNO on GRCO ($\beta = 0.013$, $p < 0.05$) and WAPR ($\beta = 0.018$, $p < 0.05$), through the mediation of ITBE. The total effect of ITBE on GRCO ($\beta = 0.153$, $p < 0.001$) and WAPR ($\beta = 0.208$, $p < 0.001$) were also found to be significant, and even after including the mediator, the effect of INTB on GRCO ($\beta = 0.153$, $p < 0.001$) and WAPR ($\beta = 0.208$, $p < 0.001$) remained significant ($\beta = 0.661$, $p < 0.001$). These data support that for green consumer and waste preventer pro-environmental behaviors, the intention to behave ecologically performs a complementary partial mediating role in the connection between TPB constructs and green consumer and waste preventer behaviors.

3.2.2. Moderation analysis

In this study, the researchers investigated the moderating effect of External Influences (EXIN) on the relationship between Intention to Behave Ecologically (ITBE), Green Consumer (GRCO), and Waste Preventer (WAPR) pro-environmental behaviors. Initially, without considering the moderating effects (EXINxITBE), the R^2 values indicated the explained variance for recycler, green consumer, and waste preventer (25.0%, 37.1%, and 33.2%, respectively) by ITBE. However, when the interaction term was included, the R^2 values increased to 25.1%, 38.0%, and 34.1% for RECY, GRCO, and WAPR, respectively, signifying increases in the variance explained of the dependent variables (0.1% for RECY, 0.9% for GRCO, and WAPR). Subsequently, the significance of the moderating effect was analyzed, and the results demonstrated a positive and significant moderating impact of EXIN on the relationship between ITBE and GRCO ($\beta = 0.059$, $p < 0.05$), and between ITBE and WAPR ($\beta = 0.059$, $p < 0.001$) supporting H_{17} and H_{18}. This finding suggests that as External influences increase, the relationship between ITBE and both GRCO and WAPR become stronger. H_{16} was rejected since the p-value was higher than 0.05. The moderation analysis summary can be found in Table 6.

Furthermore, slope analysis (Figs. 3–5) was utilized to enhance the understanding of the moderating effects. For the moderation of external influences between ITBE and RECY, the graph reveals that the line becomes steeper at lower levels of EXIN, however, maximum values reach the same, indicating no impact of EXIN finally. For the moderation of external influences between ITBE and GRCO, and ITBE and WAPR, the graphs reveal that the lines become steeper at higher levels of external influences, indicating a stronger impact of INTB on both behaviors (GRCO and WAPR) in such instances compared to lower EXIN levels. In conclusion, higher external influences amplify the influence of ITBE on both GRCO and WAPR.

The F^2 effect size was lower than 0.02 for both GRCO and WAPR behaviors. According to Cohen (1988) propositions 0.02, 0.15, and 0.35 constitute small, medium, and large effects. This shows that the moderating effect doesn't contribute significantly to explaining both endogenous constructs GRCO and WAPR.

Table 6
External influences moderation analysis.

Moderating effect	Relationship	Coefficient	t-statistics
(EXIN[a]ITBE) - > RECY		(-0.019)	1.692
	EXIN - > RECY	(0.018)	0.681
	ITBE - > RECY	0.208[b]	5.958
(EXIN[a]ITBE) - > GRCO		0.059[b]	4.244
	EXIN - > GRCO	0.057[a]	2.338
	ITBE - > GRCO	0.153	4.745
(EXIN[a]ITBE) - > WAPR		0.059[b]	4.177
	EXIN - > WAPR	0.064[a]	2.547
	ITBE - > WAPR	0.208[b]	5.958

Note. ( ) – p value > 0.05.
**p-value<0.01.
[a] p-value <0.05.
[b] p-value<0.001; ITBE: Intention to behave ecologically, RECY: Recycler; GRCO: Green consumer; WAPR: Waste preventer; EXIN: External Influences.

Table 5
Intention to behave ecologically mediating effect.

Relationship	Total Effects	Direct Effect	Indirect Effects of TPB constructs			
	Coefficient	Coefficient	TPB Constructs	Coefficient	Percentile bootstrap 95% confidence interval	
					Lower	Upper
ITBE - > RECY	(0.031)	(0.031)	ATTB	(0.020)	−0.026	0.066
			PEBC	(0.005)	−0.006	0.015
			SUNO	(0.003)	−0.00	0.011
ITBE - > GRCO	0.153[c]	0.153[c]	ATTB	0.101[c]	0.061	0.146
			PEBC	0.022[b]	0.009	0.038
			SUNO	0.013[a]	0.003	0.027
ITBE - > WAPR	0.208[c]	0.208[c]	ATTB	0.136[c]	0.091	0.184
			PEBC	0.030[b]	0.013	0.050
			SUNO	0.018[a]	0.004	0.035

Note.( ) – p value > 0.05.
[a] p-value <0.05.
[b] p-value<0.01.
[c] p-value<0.001; ITBE: Intention to behave ecologically, RECY: Recycler; GRCO: Green consumer; WAPR: Waste preventer; ATTB: Attitude toward behavior; PEBC: Perceived behavioral control; SUNO: Subjective norms.

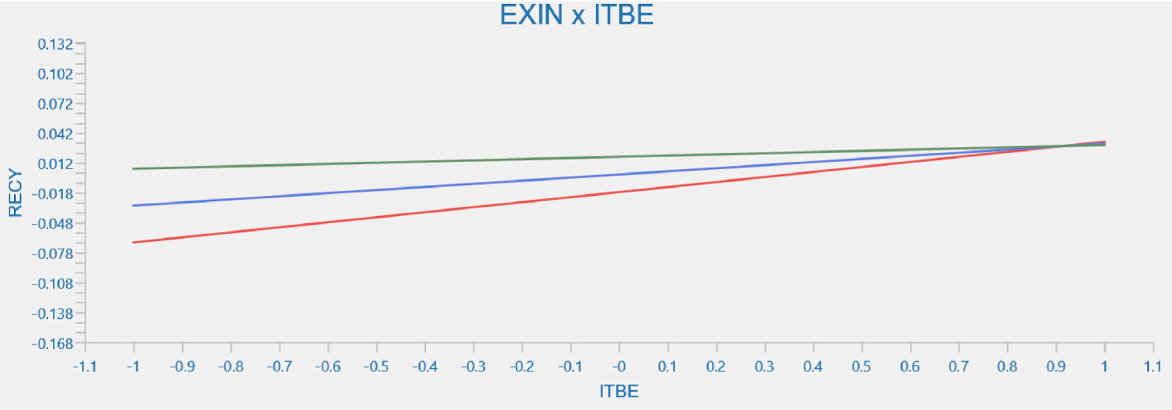

Fig. 3. Moderator slope analysis – EXINxITBE - > RECY.

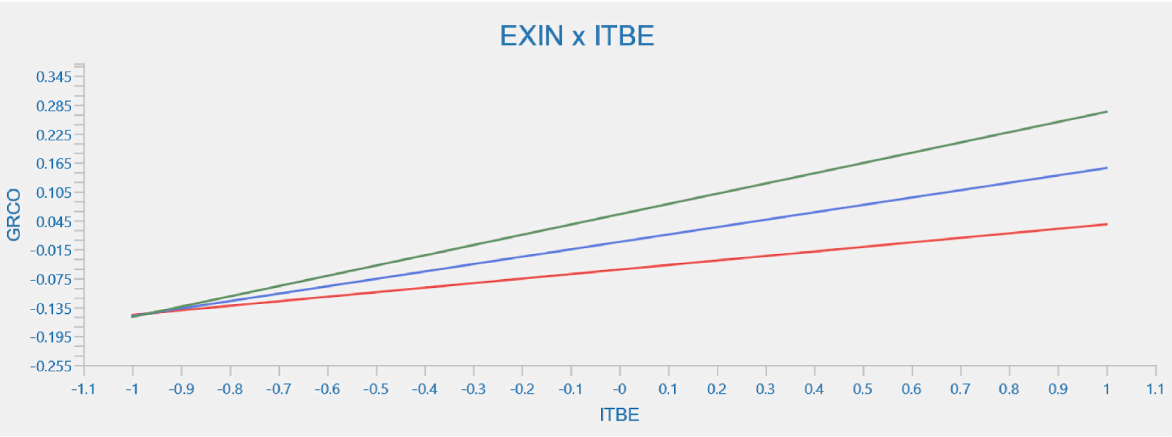

Fig. 4. Moderator slope analysis – EXINxITBE - > GRCO.

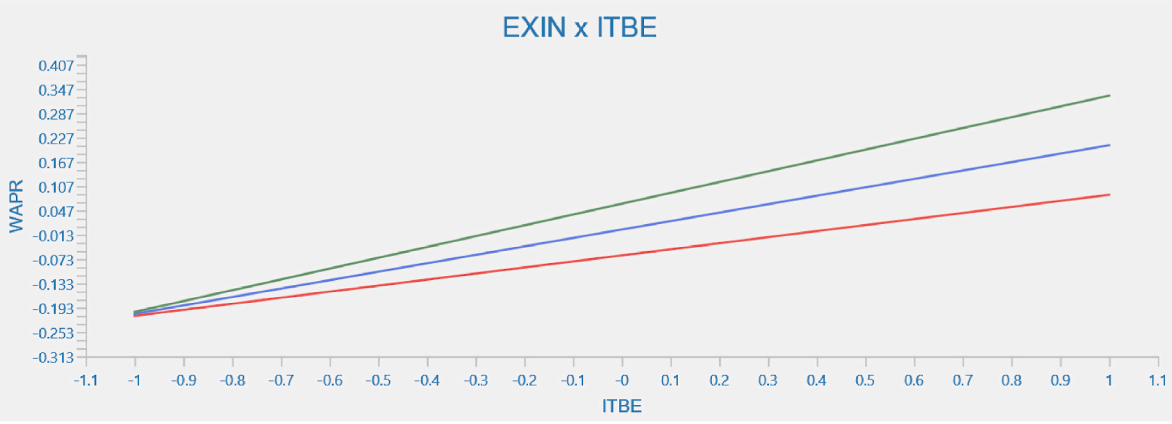

Fig. 5. Moderator slope analysis – EXINxITBE - > WAPR.

3.2.3. *Explanatory power*

The R^2 statistics quantify how much of the variance in the dependent variable can be explained by the independent variable(s).

In layman's terms, it shows how much the outcome variable fluctuates as a result of the influence of one or more predictor factors. A higher R^2 value shows that the model is better able to explain fluctuations in the dependent variable (Shmueli and Koppius, 2011), also known as in-sample predictive power (Rigdon, 2012). The R^2 value ranges from 0 to 1, with higher values suggesting greater explanatory power. Cohen (1988) provided broad standards for evaluating R^2 values for endogenous latent variables, classifying values as significant at 0.26, moderate at 0.13, and weak at 0.02. However, acceptable R^2 values can vary depending on the research environment. In some sectors, such as predicting stock returns, a lower R^2 value of 0.10 may be regarded as sufficient. In the current study (Table 7), all endogenous constructs had R^2 values more than 0.25, showing significant explanatory power according to Cohen's criterion. The impact size (F^2) is a metric for evaluating the explanatory power of individual exogenous variables in a model. It evaluates the change in R^2 when a specific exogenous construct is eliminated to determine the influence of each independent variable on

Table 7
Explanatory power.

Predictor(s)	Outcome(s)	R^2	F^2	Q^2
ITBE	RECY	0.251	0.000	0.201
ATTB			0.012	
PEBC			0.040	
SUNO			0.023	
EXINxITBE			0.001	
ITBE	GRCO	0.380	0.010	0.334
ATTB			0.003	
PEBC			0.032	
SUNO			0.005	
EXINxITBE			0.011	
ITBE	WAPR	0.341	0.017	0.292
ATTB			0.008	
PEBC			0.018	
SUNO			0.000	
EXINxITBE			0.010	
ATTB	ITBE	0.701	0.603	0.638
PEBC			0.016	
SUNO			0.007	

Note. EXIN: External Influences; RECY: Recycler; GRCO: Green consumer; WAPR: Waste preventer; ITBE: Intention to behave ecologically; ATTB: Attitude Toward Behavior; PEBC: Perceived Behavioral Control; SUNO: Subjective Norms.

the dependent variable. Following Cohen's (1988) criteria, the F^2 measures the strength of the link between latent variables in the context of a PLS path model, where a big effect size is represented by a value of 0.35, a medium effect size by 0.15, and a small effect size by 0.02. According to the findings (Table 7), the F^2 effect size for PEBC on INTB ranged from 0.000 (negligible) to 0.603 (big) for ATTB on ITBE. Finally, the Q^2 values of the endogenous constructs were greater than zero, indicating predictive relevance.

4. Discussion

Each day, a considerable volume of municipal solid waste is being discarded in the local landfill without any prior sorting in the province of Guayas (Hidalgo-Crespo et al., 2023). This lack of waste management impedes recycling efforts and poses a risk to environmental damage. Understanding the motivators behind waste reduction pro-environmental actions is critical to solving this issue, as it can provide useful insights into waste avoidance, minimization, and recycling operations. However, applying such insights can be difficult since they frequently necessitate adjustments in consumer preferences and choices, forcing individuals to embrace more environmentally friendly buying habits and alter their lifestyles accordingly.

In this context, the present research underscores the importance and effectiveness of employing psychological models, such as the theory of planned behavior, to elucidate attitudes and norms fostering pro-environmental intentions within an emerging metropolis in South America. Moreover, this psychological approach possesses the potential to impact public decision-making processes concerning environmental policies and initiatives.

Our results indicate that augmenting the TPB model with external factors as a moderator is more efficacious than employing it in isolation to anticipate residents' pro-environmental behaviors in Guayas, specifically as recyclers, green consumers, and waste preventers. The study substantiates the favorable impact of attitude, perceived behavioral control, and subjective norms on citizens' intentions to engage in environmentally friendly behaviors, suggesting that the extended TPB serves as an effective research model for comprehending citizens' pro-environmental behaviors. A significant contribution of the study lies in revealing a robust and positive association between citizens' intentions to act ecologically and pro-environmental behaviors related to waste reduction, notably facilitated by the indirect moderating role of external influences.

Among the three TPB factors, attitude toward behavior emerged as the foremost predictor of environmental behavior, with perceived behavioral control following closely. ATTB indicates how an individual perceives the consequences (both positive and negative) of their pro-environmental choices (Bamberg and Möser, 2007). Our results unveiled that individuals' aspirations for environmental responsibility play a pivotal role in shaping their participation in pro-environmental endeavors such as green shopping, recycling, and waste avoidance. By improving citizens' green attitudes, the probability of occurrence of more favorable pro-environmental behaviors will increase (Shafiei and Maleksaeidi, 2020). These findings align with prior studies by Akhtar et al. (2020) and Hojnik et al. (2019), establishing a connection between ethical, moral, and personal norms and the inclination to consume environmentally sustainable products. The effects of ATTB were also found important for the intention of separation and classification of household solid waste of three municipalities of Lima, Peru (Méndez-Lazarte et al., 2023). Other research suggests that individuals' intentions to embrace environmental responsibility may arise from a sense of guilt for not choosing green products and a moral obligation to protect the environment (White et al., 2019).

Perceived behavioral control was the most powerful predictor of both GRCO and WAPR, but not for RECY behaviors. Since PEBC indicates the level of difficulty an individual senses while performing the pro-environmental option compared to other options, it was expected that the citizens of a South American country would see that GRCO and WAPR behaviors easier than the RECY one. The perception of difficulty of RECY behavior could be due to the lack of knowledge or willingness to separate solid waste at home while the ease for the other is most likely due to the lack of necessity of additional physical and time usage. One previous research in Nkayi, Zimbabwe identified from a sample of 165 households that citizens perceive segregation and recycling activities as time consuming (Dlamini and Zikhali, 2024). Another research found that the change in 1% of a household's ability of perceived self-control increases as much as 16% in implementing a solid waste PEB while maintaining the other variables constant for Butajira town, Southern Ethiopia (Fikadu et al., 2022).

The current study advances additionally our understanding of the role of external influences as a powerful mediator of people' environmental consciousness, green consumer behavior, and waste avoidance. Our findings are consistent with those of Zhu et al. (2021), who discovered that people had a strong tendency to conform to the behavior patterns of the social majority. This uniformity is especially noticeable when it provides benefits such as saving time, effort, or money. These external effects appear to have influenced the green consumer and waste preventer behaviors in the setting of our study, since individuals may pick these two behaviors to lower their resource usage and overall expenditures. However, the contrary is also true, since consumer sustainable behavior may change if the increment of the price of sustainable products was significant (Berthold et al., 2022).

Additionally, the study found very little partial mediation between TPB components and pro-environmental behaviors via the intention to behave environmentally. This shows that improving citizens' attitudes, controls, and norms may encourage them to adopt green habits. Subsequent research could explore the influence of emotions, such as guilt and pride, on different pro-environmental behaviors, as suggested by Onwezen et al. (2013). Furthermore, prior research has shown that including moral norms into theories, such as the theory of planned behavior, increases their explanatory power, particularly for recycling behavior (Poškus, 2015).

4.1. Practical and policy implications

This investigation establishes a theoretical framework and identifies pivotal factors to guide behavior-driven waste reduction practices among citizens in metropolitan areas from developing world countries. Our findings with subjective norms importance suggest that the

deployment of intensive awareness campaigns for people lacking knowledge of the benefits of both these waste preventive behaviors could increase the likelihood of individuals executing recycling and green-consuming behaviors as proved before by Wan et al., (2017). For individuals with low subjective norms, positive reinforcement of the benefits for both the environment and society could improve individuals' acceptance of the different PEBs.

Attitudes toward behavior can spread the thought of waste reduction behaviors and increase the positivity of the vision of acting well on the three behaviors. Citizens should feel that by executing waste reduction behaviors they are helping the city, their fellow citizens, and most importantly, the environment. Local governments, municipalities, and state institutions' efforts should be focused on developing campaigns in schools, open houses, and many other accessible by the common population events, to increase the popularity of both behaviors.

Perceived behavioral control was found to also influence the population's likeliness to integrate waste reduction behaviors. Since perceived behavioral control refers to the easiness that we perceive to develop a behavior, public policies should focus on improving the perception of difficulty in realizing all three behaviors, perhaps by promoting the differentiated collection or formalizing the current informal waste collection for the area and/or facilitating recycling facilities.

Given the substantial moderating role of external factors between intentions to behave ecologically and green consumer and waste-preventer behavior, it is most necessary to cultivate word-of-mouth regarding these behaviors in the population. Finally, policymakers ought to formulate subsidies or incentives to enhance perceived behavioral control within the populace, exemplified by initiatives like the introduction of zero-charged energy consumption for induction stoves, a measure that persists to the present (Hidalgo-Crespo et al., 2019).

4.2. Limitations and future research

While our study yielded significant results, it is critical to consider its limitations. The use of cross-sectional self-reporting surveys is one such drawback, as it may bring self-report bias and social desirability bias, potentially leading to mistakes in reporting real behaviors. Furthermore, the convenience sampling approach used in this study resulted in a demographic bias toward Guayas province, which may not truly represent the entire country given the cultural disparities between coastal zones and highlands. The use of TPB framework is itself a limitation since it only measures the intentions to perform a pro-environmental behavior and not the actual behavior. Future research should include different provinces in Ecuador to improve the generalizability of the findings. In addition, the actual behaviors should be measured through experimentation and furthermore, given the potential differences in behavioral patterns across cultures and nations, a cross-cultural or cross-national study in developing countries, particularly in South America, could provide a more comprehensive knowledge of the underlying concerns.

5. Conclusions

Ecuador's emergence as a vibrant player and growing economy in South America, with a population almost reaching 3 million people, has positioned it as a potential fast-growing market for circular economy initiatives in the near future. Despite this promise, the country faces several challenges due to its low recycling rates and high dependence on informal waste collection efforts together with the increasing amounts of waste being sent to the local landfills. To address these issues, the local public and private organizations (governmental and not), in combined efforts with the production enterprises and retailers have recognized the necessity to act and intervene in the waste management process.

The research model developed in this study attempts to fill a big research gap on the South American region by using the widely recognized Theory of Planned Behavior (TPB) as the basis to analyze three different pro-environmental behaviors, recycler, green consumer, and waste preventer. The authors believe that these three behaviors are the most important to minimize the current waste being disposed of in households of the region. The research also expanded the reach of the TPB framework by incorporating external influences as catalysts to foster sustainable practices in a developing third-world city context.

Through testing various hypotheses, the study explores the intricate relationships between external influences, subjective norms, perceived behavioral control, attitude toward behavior, and specific pro-environmental behaviors such as recycling, waste prevention, and green consumerism, validating 14 out 18 in total.

The findings of this research make valuable contributions to existing literature and offer insights for more comprehensive explanations and future studies in the field. The research suggests the significant necessity to call out individuals' feelings and environmental self-awareness to encourage to encourage environmentally-friendly and waste minimization actions like green consumerism, waste prevention, and recycling.

Further research should replicate the study in other provinces of the country, closer to the highlands to compare the results and in the future continue to validate this model with other Hispanic developing countries.

CRediT authorship contribution statement

J. Hidalgo-Crespo: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **J.L. Amaya-Rivas:** Writing – review & editing, Supervision, Resources, Investigation, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clet.2024.100765.

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