

## Pro-Environmental Conservation Behavior Through the Lens of Theory of Planned Behavior

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**Abstract:** *The Theory of Planned Behavior (TPB) has emerged as a prominent theoretical framework in recent years, with its application extending to a multitude of studies examining pro-environmental conservation behaviors from both organizational and individual perspectives. This literature review was conducted with the objectives of 1) examining the pro-environmental behaviors that have been previously investigated using the TPB framework and 2) analyzing the supplementary constructs that have been incorporated in the extended version of TPB. The analysis of 56 publications revealed that a majority of the studies (92.85%) have augmented the TPB model by incorporating supplementary constructs with the aim of enhancing its predictive capabilities in relation to individuals' pro-environmental behaviors. Approximately 32.14% of the studies incorporated constructs derived from additional theories to enhance the predictive capacity of the main theory. This article highlights a notable deficit in the existing body of literature and provides valuable suggestions for potential areas of inquiry in future research.*

**Keywords:** Environment, Energy, Behavior, Conservation, Theory of Planned Behavior

### Introduction

The concept of pro-environmental behavior refers to actions undertaken by individuals with the aim of mitigating the negative impact they have on the environment (Kollmuss & Agyeman, 2002). The field of environmental psychology has demonstrated a greater inclination towards advocating for pro-environmental behavior as a viable approach to addressing environmental challenges (Steg & Vlek, 2009). According to scholarly research on pro-environmental behavior, the Theory of Planned Behavior (TPB) has been applied to various pro-environmental behaviors, including environmental conservation behavior (Esfandiar et al., 2023; Mu et al., 2023; Ong et al., 2023; Shanmugavel & Balakrishnan, 2023; Singha, et al., 2023; Sogari et al., 2023), energy conservation and or saving behavior (Ahmad et al., 2020; Khan et al., 2019; Liu et al., 2021; Ru et al., 2018; Ullah et al., 2026; Wang et al., 2023) and transportation usage behavior (Ali et al., 2023; Asadi et al., 2021; Fallah et al., 2020; Javid et al., 2022). To date, TPB continues to be the prevailing theoretical framework employed for the examination of human behavior across various domains. This assertion is supported by a substantial citation count of over 121,000 references, as reported by the Google Scholar search conducted in 2023. TPB posits that an individual's behavior is influenced by their behavioral intentions (Jaffar et al., 2024). Behavioral intentions are derived from attitude, subjective norms, and perceived behavioral control, as indicated in Figure 1 (Ajzen, 2006).

According to TPB, attitudes (ATT), which refer to an individual's subjective evaluation of the anticipated consequences, constitute the initial construct that establishes the foundation of the theory (Ajzen, 1991). The original construct of the theory, "attitude towards the environment," has been associated with a range of pro-environmental behaviors, such as recycling and environmental protection (e.g., Gansser & Reich, 2023; Mu et al., 2023; Ong et al., 2023; Singha, et al., 2023; Sogari et al., 2023), energy conservation (e.g., Khan et al., 2019; Liu et al., 2021; Wang et al., 2023), and eco-friendly transportation (e.g., Asadi et al., 2021; Fallah et al., 2020; Javid et al., 2022).

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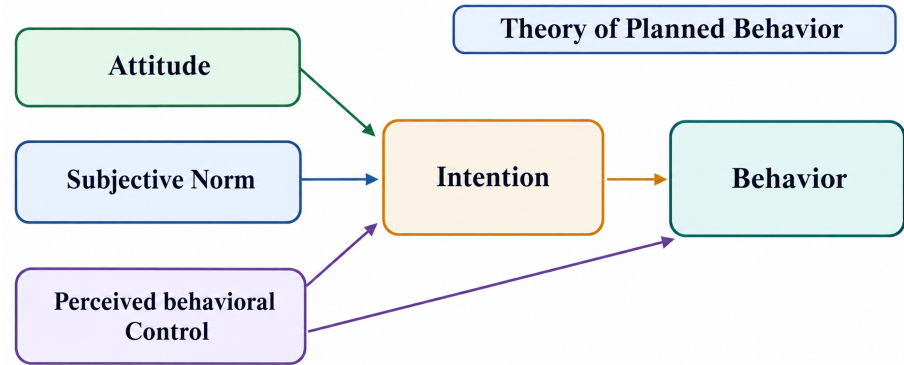
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The second TPB construct is subjective norm (SN), which is the way in which the cultural values and expectations of individuals and society can affect a person’s decision to engage in or refrain from engaging in the target behavior (Ajzen, 1991). There is a substantial body of research that supports the relationship between social norms and pro-environmental behavior. Research informs about specific social groups, such as family members and friends, in order to better understand whether or not they engage in pro-environmental behaviors, such as those highlighted in the fields of environmental protection and recycling (e.g., Maminirina et al., 2023; Mu et al., 2023; Obuobi et al., 2022; Ong et al., 2023; Rezaei et al., 2019; Shanmugavel & Balakrishnan, 2023; Shin et al., 2018; Singha, et al., 2023; Sogari et al., 2023), energy conservation (e.g., Alomari et al., 2022; Arkorful, 2022; Elahi et al., 2022; Guo et al., 2018; Hasheem et al., 2022; Irfan, Hao, et al., 2021; Li et al., 2019; Liu et al., 2021; Long et al., 2023; LTan et al., 2023; Tang et al., 2022; Wang et al., 2018; Wang et al., 2023), and use of environmental-friendly transportation (e.g., Ali et al., 2023; Asadi et al., 2021; Bobeth & Kastner, 2020; Fallah et al., 2020; Javid et al., 2022).

The third crucial construct of TPB is perceived behavioral control (PBC). According to Ajzen (1991), perceived behavioral control refers to limitations placed on engaging in a specific activity while exercising volitional control. Many studies on pro-environmental behavior and intentions have emphasized perceived behavioral control (e.g., Gansser & Reich, 2023; Ho & Tang, 2022; Maminirina et al., 2023; Mu et al., 2023; Obuobi et al., 2022; Ong et al., 2023; Rezaei et al., 2019; Shanmugavel & Balakrishnan, 2023; Shin et al., 2018; Singha et al., 2023; Sogari et al., 2023). A high level of perceived behavioral control (e.g., Maminirina et al., 2023; Mu et al., 2023; Ong et al., 2023; Rezaei et al., 2019; Singha, Chandra, et al., 2023) is linked to increased pro-environmental behavior intention and resolve to do the behavior. Thus, the degree to which people believe they can carry out a behavior in spite of internal and external constraints can be understood through their perceived behavioral control (e.g., Ho & Tang, 2022; Maminirina et al., 2023; Ong et al., 2023; Rezaei et al., 2019; Singha et al., 2023).

**Figure 1**  
Theory of Planned Behavior



Source: Ajzen, 1991

This review aimed to investigate the usage of TPB with its original (ATT, SN, and PBC) and supplementary constructs to these original ones in pro-environmental behavior. It also examined the pro-environmental behaviors that have been previously investigated using the TPB framework and the supplementary constructs that have been incorporated in the extended version of TPB. It helped us comprehend the current state of research and identify potential avenues for future studies pertaining to the application of TPB in the context of pro-environmental behavior. This review is based on a critical review of TPB original and supplementary constructs in pro-environmental behaviors, the nature of correlations, and the significance of relationships among them towards shaping pro-environmental behavior. The results of this review therefore have the potential to encourage sustainable human behavior and offer significant environmental protection implications in pro-environmental behavioral research.

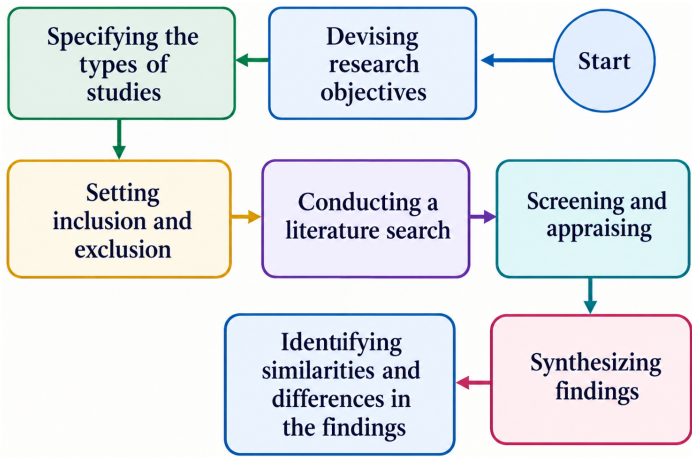
Method

This is a systematic review aiming to understand pro-environmental behavior with TPB as a theoretical framework for the reviewed work to better understand environment-responsive behavior (Jaffar & Latiff, 2024; Yuriev et al., 2020). A systematic review, according to Grant et al. (2009), maps existing literature, categorizes data, and characterizes the quantity and quality of literature, including study design and other features a review aims to achieve. A systematic review is transparent and thorough, and it follows clearly laid out protocols for defining the study objectives and extracting, screening, and synthesizing studies related to the review objectives.

This review aimed to map the literature on TPB in pro-environmental research and to address aspects of the applications of TPB in this regard. For systematic review methodology, this research followed the seven-stage model of Petticrew & Roberts, (2008). The model comprises identifying research objectives, devising literature inclusion and exclusion criteria, making literature searches, screening search results against selection criteria, conducting critical analysis of the literature, synthesizing the literature, and disseminating review findings.

In the first stage, the objectives of the systematic review of the most pertinent literature on pro-environmental behavior were formulated. The first objective was to understand the trend of research applying TPB to pro-environmental behavior. The trend encompassed the rate of publications produced in different regions of the world and the journals publishing those studies. The second objective was to explore research studies that have used supplementary constructs employing TPB to study pro-environmental behavior.

Figure 2  
Process of Systematic Review



Source: Authors

The second stage involved describing the types of studies in terms of using TPB constructs and methodologies. It aimed to retain the most recent insights that are more credible once they have gone through the rigorous review process adopted by those journals (Soderberg et al., 2020). This review aimed to investigate more recent empirical work published in peer-reviewed journals since 2018. Herber and Barroso (2020), in addition to research focus, approaches, and methodologies, also refer to the cut-off dates of literature integral to the methodologies of systematic review. This review's cutoff date was from 2018 to 2023 to perform a robust and updated systematic review of pro-environmental behavior. The authors selected three widely used academic databases for the peer-reviewed article searches on pro-environmental behavioral research applying TPB. These databases included Scopus, Web of Science, and Google Scholar.

The third stage of the review involved looking up relevant literature. To ensure that literature reviews include only the most pertinent publications, inclusion and exclusion criteria were developed (Table1), as

proposed by Colquhoun et al. (2014) and Daudt et al. (2013). The criteria encompassed the inclusion of empirical and theoretical work published in peer-reviewed journals from 2018 to 2023. Conceptual papers and those published before 2018, conference papers, editorials, book chapters, and working papers were not included. The reason for not including them was the review's narrow inclusion criteria, which provide a specific overview of the phenomenon under discussion (Hackenbroich et al., 2022). Others (e.g., Adams et al., 2017) term such works as grey literature containing the diverse and heterogeneous body of material available outside which could be included; however, it is the purpose of the review that determines the inclusion of such literature (Boote & Beile, 2005).

**Table 1**

*Inclusion and Exclusion Criteria*

| Selection criteria | Inclusion criteria                                         | Exclusion criteria                                           |
|--------------------|------------------------------------------------------------|--------------------------------------------------------------|
| Methodology        | Empirical, Theoretical                                     | Conceptual                                                   |
| Time               | 2018 Onward                                                | Before 2018                                                  |
| Studied behaviors  | Direct effects (e.g., recycling, energy-saving activities) | Indirect effects (e.g., behaviors of consumers)              |
| Studies            | Peer-reviewed articles                                     | Conference papers, editorials, book chapters, working papers |

Source: Authors

The fourth stage is comprised of the search strategy. The search strategy involved utilizing keywords related to TPB and pro-environmental behavior. The keywords employed for pro-environmental included "pro-environmental," "environmental," "sustainable," "responsible," "ecological," and "green behavior" and the keywords for individual included "human," "individual, and individuals". The difference in spellings such as "behavior" or "behaviour" was also used during the search stage. The terms used to collect the articles; the search process resulted in the discovery of 822 relevant documents. We read the abstracts of all 822 articles to further decide their relevance to the research topic and the methodology of the literature review.

During the fifth stage, the initial sorting process, the researchers employed a criterion wherein articles were excluded based on the content of their abstracts and titles. Specifically, studies that simply mentioned TPB without using it were excluded from consideration. All the authors also conducted separate assessments of the manuscripts in a parallel and independent manner. The researchers engaged in a comparative analysis of their respective findings and identified a total of 123 articles that were deemed relevant and agreed upon during the discussion sessions. During the second phase of sorting, the selection of publications was refined by excluding articles that did not meet the predetermined inclusion and exclusion criteria as indicated in Table 1. As a result, the total number of chosen publications was reduced to 56. The outcomes of the search, screening, and selection processes are depicted in Figure 2. The reviewers' findings were deliberated upon and subsequently resolved, despite the presence of discrepancies. Firstly, conceptual papers were excluded from the review because the study only focused on empirical and theoretical findings. Secondly, publications before 2018 were excluded because the study was concerned with the last five years of studies. Thirdly, publications that focused on the direct effects on the environment (such as recycling, conserving energy, water, and so forth) were included. As a result, articles that were based on indirect effects on the environment were excluded (e.g., stores, consumer goods, hotels, etc.). Finally, peer-reviewed publications were included for review, and conference papers, editorials, book chapters, and working papers were excluded. A total of 67 studies were considered pertinent, and the authors acquired the complete text of the articles for the purpose of review.

Stage six involved synthesizing the literature, while stage seven involved a comparative analysis to understand the use of TPB in energy conservation behavior. As recommended by Colquhoun et al. (2014), researchers developed the data extraction grid at this stage using Microsoft Excel. The researchers developed an Excel sheet that consisted of a total of 14 columns, which were further categorized into two distinct groups.

The groups provided data pertaining to the application of TPB as well as general publication details (Table 2). The general information encompassed various elements, including the article title, journal name, year of publication, methodology, context, studied behaviors, and respondent types. The theory and constructs group included elements such as independent and mediating variables, the rationale for supplementary constructs, and the rationale for integrating constructs. Comparisons of the extracted data were made between the outcomes of this initial extraction, as shown in Table 2.

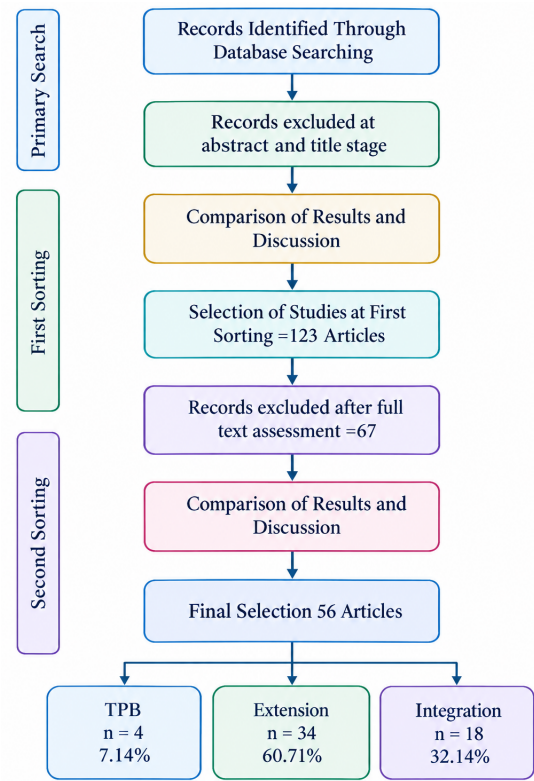
**Table 2**  
*Description of Extracted Data*

| Group 1. General information | Group 2. Application of The Theory                      |
|------------------------------|---------------------------------------------------------|
| Article title                | Dependent variables (mediating variables?)              |
| Journal name                 | Original constructs of TPB                              |
| Year of publication          | Supplementary constructs of TPB                         |
| Methodology                  | Rationale for Supplementary constructs of TPB           |
| Context                      | Integration of TPB theoretical constructs               |
| Population and sample        | Rationale for integration of TPB theoretical constructs |
| Studied behaviors            | Results                                                 |

Source: Authors

The collating, summarizing, and reporting of results were based on inclusion and exclusion criteria. The reporting of results was broken down into two steps, much like the data extraction process. The "general information" columns of the Microsoft Excel sheet were primarily based on title, journal, time, methodology, context, respondent type, and studied behaviors. The "application of the theory" columns of the Microsoft Excel sheet were primarily based on dependent variables, original constructs, supplementary constructs, rationale for supplementary constructs, integration of theory constructs, rationale for integration of theory constructs, and results.

**Figure 3**  
*Overview of Results in the Process of Searching, Screening, and Selection Process*



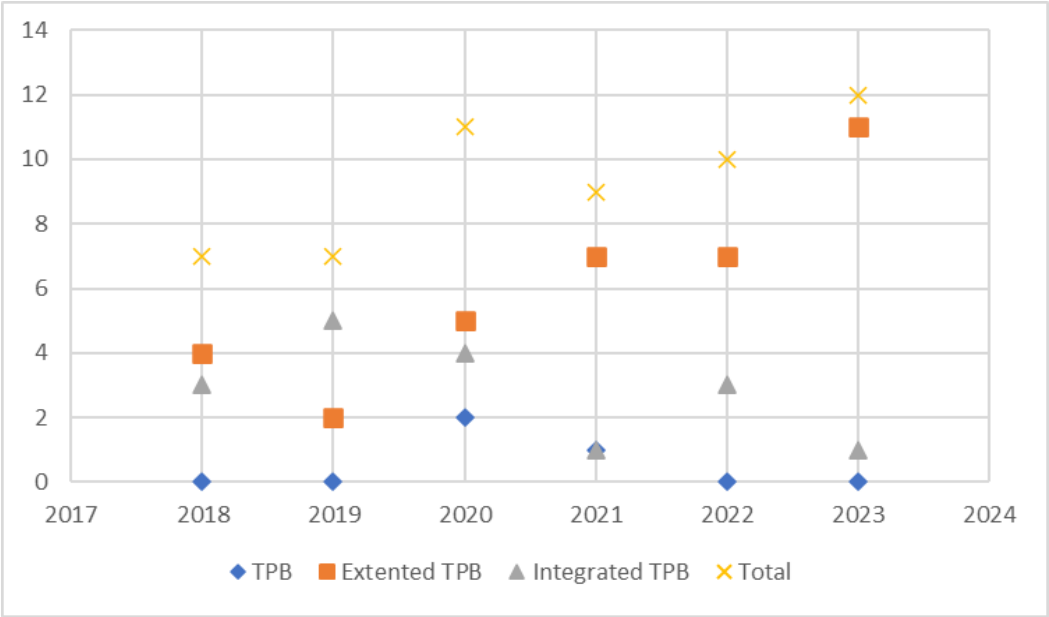
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Results

Research Trend: Applying TPB in Pro-Environmental Behavior

The literature trends were emphasized in the following aspects: the TPB's historical popularity, the preferred study designs, and the variety of studied behaviors in extended versions of the TPB. The use of the TPB was then examined, with particular attention paid to the framework and the provided statistical findings. The publication output for TPB used in pro-environmental research in original, extended, and integrated format trends is shown over the period 2018 to 2023 (Figure 2). It can be seen that 60.71% have used the extended, 32.14% have used the integrated, and only 7.14% have employed the original constructs of TPB in studying pro-environmental behavior. Figure 2 also demonstrates that since 2018, there has been a significant increase observed in the overall category, with 71.4% of empirical research articles that support environmental behavior. The trends in the extended version of TPB explain a massive increase of 175% (an increase from 4 studies in 2018 to 11 studies in May 2023). It is anticipated that the study of pro-environmental behavior will continue to grow as public and global awareness of environmentally responsible human behavior increases (Arkorful, 2022; Asadi et al., 2021; Javid et al., 2022; Obuobi et al., 2022). The findings of this review point to the interdisciplinary nature of TPB-based pro-environmental research, which combines expertise and research methodologies from various fields.

Figure 4  
Literature Trend



Source: Authors

The journals by number of publications in terms of journal representations are shown in Table 4. More than half (60.71%) of the 56 articles are published in nine journals, as presented in Table 4, and among them, the journal Energy Policy has published 12.5%, Resources, Conservation & Recycling and the Journal of Cleaner Production and Resources, Conservation & Recycling have published 10.71%, and the Journal of Environmental Management has published 7.14%. The results show that 34 out of 56 studies are published in nine journals (as mentioned in Table 4) by the number of publications, while 22 out of 31 journals have published a single study from a selected range of studies.

**Table 4***Journals by the Number of Publications*

| List | Journal                                                | No of Publications | Precent |
|------|--------------------------------------------------------|--------------------|---------|
| 1    | Energy Policy                                          | 7                  | 12.50%  |
| 2    | Journal of Cleaner Production                          | 6                  | 10.71%  |
| 3    | Resources, Conservation & Recycling                    | 6                  | 10.71%  |
| 4    | Journal of Environmental Management                    | 4                  | 7.14%   |
| 5    | International Journal of Hospitality Management        | 3                  | 5.35%   |
| 6    | Energy Research & Social Science                       | 2                  | 3.57%   |
| 7    | Environmental Impact Assessment Review                 | 2                  | 3.57%   |
| 8    | Sustainable Energy Technologies and Assessments        | 2                  | 3.57%   |
| 9    | Transportation Research Interdisciplinary Perspectives | 2                  | 3.57%   |
|      | Others                                                 | 22                 | 39.28%  |

Table 5 depicts the country-wise statistics of energy conservation using TPB. It was found that in terms of the proportion of publications, China remains at the top (42.86%), followed by Pakistan second (8.93%) and Iran third (7.14%).

**Table 5***Country-wise Publications*

| Country                                                                                                                                           | No of studies | Percent |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|
| China                                                                                                                                             | 24            | 42.86%  |
| Pakistan                                                                                                                                          | 5             | 8.93%   |
| Iran                                                                                                                                              | 4             | 7.14%   |
| Germany                                                                                                                                           | 2             | 3.57%   |
| India                                                                                                                                             | 2             | 3.57%   |
| Japan                                                                                                                                             | 2             | 3.57%   |
| Korea                                                                                                                                             | 2             | 3.57%   |
| Others (Philippines, Netherlands, Egypt, Ghana, Indonesia, Malaysia, Norway, USA, Turkey, and comparative analysis of cross-country comparisons). | 15            | 26.78%  |

Source: Authors

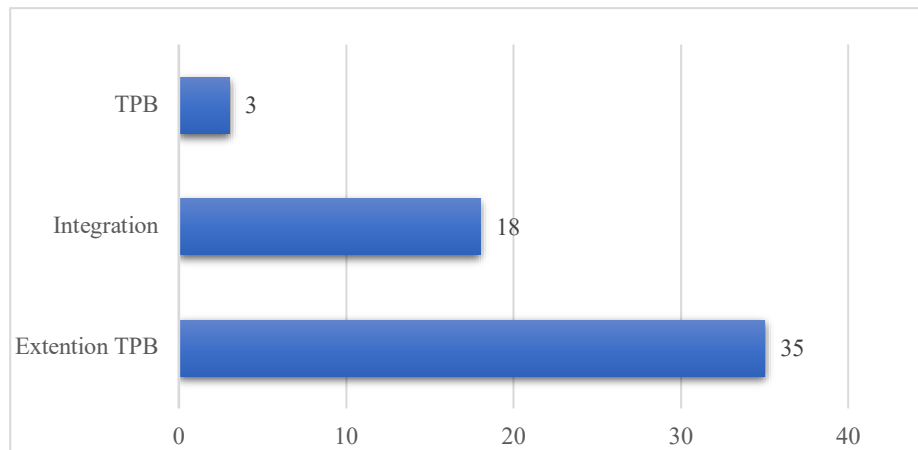
### Supplementary Constructs used to TPB towards Studying Pro-Environmental Behavior

The results identified the importance of extending TPB with supplemental constructs. The results show that around 5% of the studies (e.g., Alvi et al., 2020; Gonçalves et al., 2021) are based on original constructs of TPB. Around one-third of the studies (32.14%) (e.g., Asadi et al., 2021; Maminirina et al., 2023; Obuobi et al., 2022) integrated constructs from other behavioral models into TPB (e.g., NAM by Maminirina et al., 2023 and VBN by Ho & Tang, 2022). The majority of the studies (62.5%) have employed the extended version of TPB (e.g., Gansser & Reich, 2023; Long et al., 2023; Ong et al., 2023; Singha et al., 2023) (Figure 4). These results indicate that researchers prefer the extension of TPB to increase the predictive power of their study models in pro-environmental research (e.g., Gansser & Reich, 2023; Long et al., 2023; Ong et al., 2023; Singha et al., 2023; Sogari et al., 2023). The supplementary variables existed in fifteen main categories, as presented in Table 3. Each category of variable has been further explained in subconstructs. The category “cost and benefit beliefs”, for example, was found with the constructs of benefits belief, financial benefits, and relative advantages (Elahi et al., 2022; Hasheem et al., 2022; Elavarasan et al., 2021). The “involvement” was investigated within community involvement and neighbors’ participation, as highlighted by the relevant research (Elavarasan et al., 2021; Singha, Karmaker, et al., 2023; Tang et al., 2022). The category “concerns” was viewed in research in terms of concerns, including energy security concerns, disaster concerns, and

environmental concerns (Ali et al., 2023; Gansser & Reich, 2023; Guo et al., 2018). The phenomenon of “knowledge” as an additional construct was examined from the perspective of environmental knowledge in pro-environmental research (e.g., Alomari et al., 2022; Elahi et al., 2022; Mu et al., 2023; Shanmugavel & Balakrishnan, 2023). Likewise, the category “values” was used to extend TPB within the context of cultural values in pro-environmental behavioral research (e.g., Pagliuca et al., 2022; Su et al., 2021).

**Figure 5**

*Theoretical Frameworks of the studies*



Source: Authors

**Table 3**

*Extended Version of The Theory of Planned Behavior*

| Variable Category        | Constructs                                                                        | Studies (Examples)                                                                               |
|--------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Cost and Benefit Beliefs | Benefits Belief, Financial Benefits, Relative Advantages                          | Elahi et al., 2022; Hasheem et al., 2022; Irfan, Elavarasan, et al., 2021                        |
| Involvement              | Community Involvement, Neighbors' Participation                                   | Irfan, Elavarasan, et al., 2021; Singha, et al., 2023; Karmaker, et al., 2023; Tang et al., 2022 |
| Concerns                 | Concerns, Energy Security Concern, Disaster Concern, Environmental Concern        | Ali et al., 2023; Gansser & Reich, 2023; Guo et al., 2018                                        |
| Knowledge                | Knowledge, Environmental Knowledge                                                | Alomari et al., 2022; Elahi et al., 2022; Mu et al., 2023; Shanmugavel & Balakrishnan, 2023      |
| Values                   | Values, Cultural Values                                                           | Pagliuca et al., 2022; Su et al., 2021                                                           |
| Risk                     | Risk, Risk Perception                                                             | Ahmmadi et al., 2021; Mu et al., 2023                                                            |
| Personality              | Self- Identity, Self-Effectiveness, Self-Transcendence                            | Ahmad et al., 2020; Irfan, Hao, et al., 2021; Wang et al., 2021                                  |
| Environmental Perception | Environmental Perception, New Environmental Paradigm, Environmental Consciousness | Liu et al., 2021; Ru et al., 2018; Zhang et al., 2020                                            |
| Lifestyle                | Convenience, Lifestyle, Connectedness To Nature                                   | Hasheem et al., 2022; Khan et al., 2019                                                          |
| Policy                   | Government Response, Media, Policy Environment, Policy Effectiveness              | Ong et al., 2023; Tan et al., 2023                                                               |

| Variable Category | Constructs                                            | Studies (Examples)                                                                            |
|-------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Motivation        | Motivation, Protection Motivation, Hedonic Motivation | Ong et al., 2023; Y. Wang et al., 2019                                                        |
| Personal          | Ethics, Religion, Emotion                             | Agag & Colmekcioglu, 2020; Singha, et al., 2023; Karmaker, et al., 2023; Wang et al., 2018)   |
| Responsibility    | Responsibility, Environmental Responsibility          | Shanmugavel & Balakrishnan, 2023; Singha, et al., 2023; Karmaker, et al., 2023)               |
| Awareness         | Awareness, Awareness of Consequence                   | Alomari et al., 2022; Esfandiar et al., 2023; Singha, et al., 2023; Karmaker, et al., 2023)   |
| Personal Norms    | Personal Norms, Personal Moral Norms                  | Ali et al., 2023; Esfandiar et al., 2023; Long et al., 2023; Shanmugavel & Balakrishnan, 2023 |

Source: Authors

The variable of "risk" in the context of pro-environmental behaviors has been studied in relation to risk perception (Ahmmadi et al., 2021; Mu et al., 2023). The concept of "personality" has been examined within the domains of self-identity, self-efficacy, and self-transcendence (Ahmad et al., 2020; Irfan et al., 2021; Hao et al., 2021; Wang et al., 2021). One of the constructs that exhibited a strong association was the concept of "environmental perception," which was examined within the context of the extended TPB. Studies by Liu et al. (2021), Ru et al. (2018), and Zhang et al. (2020) are notable examples of those that examined this construct. Research (Hasheem et al., 2022; Khan et al., 2019) has also examined the relationship between prevention behavior and related factors such as convenience, lifestyle, and connectedness to nature within the context of pro-environmental behavior. The variable of "policy" has been extensively examined within the framework of government response, media, policy environment, and policy effectiveness, yielding significant impacts on pro-environmental behavior (e.g., Ong et al., 2023; Tan et al., 2023).

A sufficient number of studies (Ong et al., 2023; Wang et al., 2019) have investigated "motivation" with constructs of protection motivation and hedonic motivation. Motivation, along with emotions, ethics, and religion, has been found to play a significant role in influencing pro-environmental behavior (Agag & Colmekcioglu, 2020; Singha et al., 2023; Karmaker et al., 2023; Wang et al., 2018). Shanmugavel and Balakrishnan (2023), as well as other researchers (e.g., Singha et al., 2023; Karmaker et al., 2023), have conducted studies on the relationship between responsibility, awareness of responsibility, and environmental responsibility as predictors of pro-environmental behavior. Additionally, these factors encompass the concept of "personal norms," which refers to an individual's personal moral standards (Ali et al., 2023; Esfandiar et al., 2023; Long et al., 2023; Shanmugavel & Balakrishnan, 2023).

These supplementary variables, as this review reveals, encompass an expanded scope of awareness, specifically pertaining to the understanding of the consequences and benefits associated with one's behavior (Alomari et al., 2022; Esfandiar et al., 2023; Singha et al., 2023; Karmaker et al., 2023). One could posit that the findings of the review exhibit a more profound inclination towards examining pro-environmental behavior within the framework of TPB during the timeframe spanning from 2018 to May 2023. The data presented in Figure 3 show that researchers have been using this theory more and more over time. The findings demonstrate a substantial and consistent predictive capacity of the TPB across various situations and contexts, considering pro-environmental behavior.

## Discussion

Pro-environmental behavior is a complex phenomenon, and TPB remains a prominent predictor with supplementary constructs in this context. It was found that 60.71% of the research has used extended, 32.14% has used integrated, and only 7.14% has employed the original constructs of TPB in studying pro-

environmental behavior. Since 2018, there has been a significant increase in the number of empirical studies (71.4%) using TPB in pro-environmental behavior, which indicates the relevance and reliability of TPB in environmental behavior research.

The results of this systematic review show a significant increase in model productivity when supplementary constructs are added to TPB. The additional variables and constructs in a pro-environmental context encompass, for example, benefits belief (e.g., Elahi et al., 2022), community involvement (e.g., Singha, et al., 2023), concerns (e.g., Ali et al., 2023), knowledge (e.g., Mu et al., 2023), values (e.g., Pagliuca et al., 2022), risk (e.g., Mu et al., 2023), self-identity (e.g., Ahmad et al., 2020), environmental perception (e.g., Liu et al., 2021), convenience (e.g., Hasheem et al., 2022), government response and motivation (e.g., Ong et al., 2023), emotion (e.g., Singha, et al., 2023), environmental responsibility (e.g., Karmaker, et al., 2023), awareness (e.g., Esfandiar et al., 2023), and personal norms (e.g., Shanmugavel & Balakrishnan, 2023). Despite the popularity and usefulness of the TPB's original constructs, the majority of the research suggests their extension by adding additional constructs to better predict individuals' pro-environmental behavior. Likewise, in research on pro-environmental behavior, additional constructs like benefit beliefs, involvement, and concerns are found to increase the model's predictive power (e.g., Ali et al., 2023; Elahi et al., 2022; Hasheem et al., 2022; Elavarasan et al., 2021; Singha et al., 2023; Karmaker et al., 2023). Singha et al. (2023), for example, highlighted a direct relationship between involvement and water-saving intentions, while Tang et al. (2022) explained a moderating effect on intention and behavior. The possible nature of the difference is noticed with differences in involvement level, for example, individual involvement and community involvement, which differ in scale and purpose from an individual to a more collective one. Likewise, the supplementary variable of concerns has a significant direct (Mu et al., 2023) and indirect effect (Gansser & Reich, 2023). In this case, the difference in effect is described by the nature of relations that may be due to general rather than environmentally specific concerns, such as energy security concerns (e.g., Egoistic, altruistic, and biospheric). However, a significant change in relationships is observed, with the prominent effect of concerns about behavioral intentions in both the direct and indirect relationship scenarios.

The available research has found that the supplementary constructs knowledge, values, and risk raise the model's predictivity in environmental research (e.g., Alomari et al., 2022; Elahi et al., 2022; Mu et al., 2023; Pagliuca et al., 2022). A body of research (e.g., Hasheem et al., 2022; Mu et al., 2023; Obuobi et al., 2022; Xie et al., 2021) has found that the construct of knowledge directly influences individual behavioral intentions, while (e.g., Alomari et al., 2022; Liu et al., 2021; Shanmugavel & Balakrishnan, 2023; Su et al., 2021) highlighted an indirect association between knowledge and individuals' behavioral intentions. Moreover, Kim & Hwang, (2020) explain the moderating role of knowledge. The associated reasons pertain to general and specific types of knowledge and levels of knowledge among different samples with geographic locations. The pro-environmental behavior research also reveals values' prominence and has been found effective with an indirect effect. The study of Ahmad et al., (2020) and Ateş, (2020) found that one's values have an indirect effect on intentions through attitude and subjective norms. It was interesting to note that values did affect intentions via perceived behavioral control in the field of tourism but were a stronger predictor of perceived behavioral control in waste management (Lou et al., (2022)). These results portray values with different interpretations and attachments that individuals associate with and are defined by the context or environment (e.g., energy, waste management, tourism, recycling).

The effect of risks is also prominent in pro-environmental behavior research. The studies of Cahigas et al. (2023) and Mu et al. (2023) are relevant examples of the association between risk and behavioral intentions. However, Cahigas et al. (2023) found that risk was an insignificant predictor of behavioral intentions when used as a supplementary construct, while Mu et al. (2023) found it to be a significant predictor in this regard. Similar to values, risk also seems dependent on the context of the individuals, the intensity of risks associated with certain behaviors, or their capability of performing certain behaviors.

Motivation, convenience, and emotions are also reflected as glaring supplementary constructs in research. They are found to have a significant effect on pro-environmental behavior. The construct of motivation is investigated as a direct predictor of intentions (e.g., Singha et al., 2023) while the study of Cahigas et al., (2023), highlighted motivation as an indirect predictor of intentions when studied as a mediator (e.g., Li & Wu, 2019). Similarly, emotion is shown to affect individuals' behavior (Savari et al., 2021; Wang et al., 2018). These types of emotions, such as pride and guilt, are considered to affect the relationship with behavior (Savari et al., 2021). Likewise, the supplementary constructs of personal norms, awareness, and responsibility are found to play an important and significant role in increasing the predictive power of the TPB (Ali et al., 2023; Esfandiar et al., 2023; Long et al., 2023; Shanmugavel & Balakrishnan, 2023). According to the research (e.g., Arkorful, 2022; Asadi et al., 2021; Maminirina et al., 2023; Obuobi et al., 2022), personal norms through ascription of responsibility and awareness of consequences with the fundamental constructs of TPB attitude, subjective norm, and perceived behavioral control positively affect individuals' behavioral intentions. On the other hand, some (e.g., Fallah Zavareh et al., 2020; Javid et al., 2022) do not explain the positive relationship of personal norms towards pro-environmental behavior. Fallah Zavareh et al. (2020) have found that personal norms have no influence on individual behavioral intentions, and Javid et al. (2022) have also confirmed a negative relationship between personal norms and intentions. One reason noted is that the positive and negative relationship between personal norms and intentions depends on the field of study, whether an individual operates independently or acts within set parameters such as a particular cultural setting or organizational bindings, leaving less room for individuals to exercise their free will and choices. This is where the TPB is found, with limitations and offering low predictive power when focusing solely on self-interest (e.g., Asadi et al., 2021; Obuobi et al., 2022; Rezaei et al., 2019).

The review highlights differences in the effect of TBP with the original and supplemental constructs and the purpose and field of research. This review supports the stance that the extended version of the theory of planned behavior increases its predictive power (Esfandiar et al., 2023; Gansser & Reich, 2023; Ho & Tang, 2022; Maminirina et al., 2023; Mu et al., 2023). It could be interpreted that without additional constructs, the TPB might not fully explain pro-environmental behavior because it is frequently influenced by beliefs and considerations that change over time and are context-specific, and changes in context will influence beliefs and behaviors (Clarke, 2018). Framing additional constructs in TPB seems appropriate for modeling in pro-environmental research. However, the results from one specific area of the environment cannot be generalized to other areas of the environment due to certain factors like demographics, knowledge and literacy, cultural values, personal norms, emotions, and certain risk factors.

## Conclusion

TPB continues to be an effective framework for studying pro-environmental behavior and becomes more powerful when employed with more relevant supplementary constructs. Nevertheless, there exists a divergence in the way TPB is employed, specifically with regards to its fundamental constructs such as attitudes, social norms, and perceived behavior control, and the additional ones that the literature has introduced as additional or supplementary constructs like motivation (Ong et al., 2023), risk (Mu et al., 2023), convenience (Hasheem et al., 2022), responsibility (Karmaker et al., 2023), consequence and benefits (Esfandiar et al., 2023; Singha et al., 2023; Karmaker et al., 2023), and policy (Tan et al., 2023). These and similar constructs have garnered significant attention due to their potential impact on human pro-environmental behavior. This review has helped in understanding the disparities in effects and predictability associated with these additional constructs and exploring the possibility of novel TPB use in future pro-environmental behavior research. This review's contention is that human activity plays a significant role in the present condition of the environment, and the outcome of ecological improvement or deterioration hinges on the adoption of sustainable human pro-environmental conduct. Our conclusion in this regard also considers the environment and humans as correlated; the social environment, comprised of values, norms, and learning, has a considerable effect, but with intensity across different contexts and disciplines. Moreover,

the predictive ability of such and similar constructs could be differently affected by the research purpose and methodology. It is quite visible in research that TPB, as a theoretical framework, remains relevant and possesses significant credibility when aiming to study intention-focused approaches, adaptability, and real-world applications. The absorptive nature of TPB, in terms of being quite open to the integration of supplementary constructs, makes it more relevant to study pro-environmental behavior.

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