



Environmental Awareness and Pro-Environmental Behavior: A Systematic Literature Review and Future Research Agenda

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Abstract. This systematic literature review examines research on environmental awareness and pro-environmental behavior, with particular attention to the awareness-behavior gap, publication development, thematic patterns, and future research priorities. The manuscript's existing PRISMA diagram reports 161 included records, and its publication-trend figure covers 2016–2026. Descriptive publication analysis and VOSviewer keyword co-occurrence mapping identify five interconnected themes spanning sustainability transformation, psychological and social influences, measurement and population characteristics, sustainable practices, and circular economy. Across the cited literature, awareness is relevant but does not necessarily translate into observable action; attitudes, norms, perceived control, moral responsibility, institutional support, and practical constraints merit consideration. Given the descriptive nature of the review, the keyword network cannot establish causal pathways. Priority research directions include longitudinal and experimental tests of integrated Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN), and Norm Activation Model (NAM) constructs against measured waste reduction, resource conservation, and sustainable purchasing. Such work can inform Sustainable Development Goal (SDG) 12 on responsible consumption and production and SDG 13 on climate action. **Keywords:** Environmental awareness; Pro-environmental behavior; Systematic literature review; Sustainability; Environmental psychology.

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1. Introduction

Environmental challenges, including climate change, biodiversity loss, resource depletion, and increasing environmental degradation, have become critical global concerns that threaten ecological stability and human well-being. Although technological innovations, environmental regulations, and institutional initiatives have been widely developed to address these challenges, achieving long-term sustainability requires substantial changes in human behavior. Individual actions, such as reducing waste generation, conserving energy, adopting sustainable consumption patterns, and participating in environmentally responsible activities, represent essential components in mitigating environmental problems. (Zhang & Cao, 2025). Consequently, understanding the psychological and social factors that encourage individuals to engage in environmentally responsible behavior has become an important research agenda within sustainability and environmental studies. Among these factors, environmental awareness has received considerable attention due to its potential role in shaping individuals' perceptions, attitudes, and behavioral responses toward environmental issues. (Plohl et al., 2026; Smadi & Al Rawwad, 2026).

Environmental awareness is widely recognized as a fundamental determinant of individuals' responses toward environmental challenges. The concept generally refers to an individual's understanding of environmental problems, recognition of the consequences of human activities on ecosystems, and awareness of the importance of environmental protection. Higher levels of environmental awareness are often expected to encourage individuals to adopt pro-environmental behaviors, including recycling, energy conservation, sustainable consumption, and participation in environmental initiatives (Zhang & Cao, 2025). However, previous studies have demonstrated that environmental awareness does not always translate directly into actual environmental action. Individuals may possess strong environmental knowledge and concern while still maintaining unsustainable behavioral patterns (Carducci et al., 2021; Suryani & Ali, 2026; Wyss et al., 2022). This inconsistency, commonly referred to as the awareness-behavior gap, highlights that the relationship between environmental awareness and pro-environmental behavior is complex and cannot be fully explained by awareness alone. Therefore, further investigation is required to understand the theoretical mechanisms underlying the transformation of environmental awareness into behavioral outcomes.

Pro-environmental behavior has been extensively studied as a key pathway through which individuals contribute to environmental sustainability. Such behaviors include various voluntary and intentional actions aimed at minimizing negative environmental impacts, such as waste reduction, sustainable purchasing, resource conservation, and environmentally responsible lifestyle choices. Existing literature has examined the relationship between environmental awareness and pro-environmental behavior across diverse contexts, including consumer behavior, environmental education, tourism, workplace sustainability, and community engagement. While many empirical studies suggest a positive association between environmental awareness and environmentally responsible actions, findings remain inconsistent across different populations and contexts (Liobikienė & Poškus, 2019; Omarova & Jo, 2022; Subarno et al., 2026). These variations suggest that the relationship between awareness and behavior may depend on underlying psychological processes, social influences, and contextual conditions. As a result, researchers have adopted various theoretical perspectives to explain how individuals develop environmental awareness and how such awareness contributes to behavioral change.

The theoretical foundation underlying the relationship between environmental awareness and behavioral change has been extensively explored through several behavioral theories, including the Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN) theory, and the Norm Activation Model (NAM). These theoretical perspectives suggest that individual awareness, personal values, perceived responsibility, social norms, and perceived behavioral control collectively shape environmental intentions and actions. However, despite substantial empirical evidence supporting the positive relationship between environmental awareness and pro-environmental behavior, previous studies have revealed that awareness does not always translate directly into actual environmental actions (Colombo et al., 2023; Liobikienė & Poškus, 2019; Wei et al., 2026). This phenomenon, commonly referred to as the environmental awareness-behavior gap, indicates that individuals may possess sufficient knowledge and concern about environmental issues but fail to consistently engage in sustainable practices.

The complexity of this relationship has encouraged scholars from diverse disciplines, including environmental psychology, sustainability management, consumer behavior, education, and organizational studies, to investigate various determinants, mechanisms, and contextual factors affecting pro-environmental behavior. Existing studies have examined environmental awareness in different settings, such as household consumption, workplace sustainability, tourism behavior, environmental education, and green purchasing decisions. Furthermore, recent research has expanded the discussion by incorporating emerging perspectives, including environmental literacy, moral responsibility, digital environmental communication, social influence, cultural differences, and technological interventions (Carducci et al., 2021; Fu et al., 2017; Khusniati et al., 2023; Lin et al., 2026). These developments indicate that research on environmental awareness and pro-environmental behavior has evolved considerably, reflecting increasing theoretical diversity and methodological complexity.

Environmental literacy and culturally situated educational approaches provide an additional perspective on awareness formation, although their behavioral effects require direct evaluation (Khusniati et al., 2023). Nevertheless, despite the growing volume of academic contributions, the existing literature remains fragmented due to differences in conceptual definitions, theoretical approaches, research contexts, and methodological designs. Previous studies have primarily focused on examining direct relationships between environmental awareness and specific environmental behaviors, while fewer studies have systematically mapped how this research field has developed over time, identified dominant research themes, and evaluated emerging directions for future investigation (Kayhalak & Karaküçük, 2026; Wang et al., 2025). As a result, a comprehensive understanding of the intellectual evolution and future trajectory of environmental awareness and pro-environmental behavior research remains limited.

A systematic literature review (SLR) provides a structured framework for locating, screening, and synthesizing evidence. Bibliometric and keyword co-occurrence analyses complement the narrative synthesis by describing publication patterns and conceptual associations, but neither method alone determines the strength or causality of behavioral relationships.

This study examines the development of publications on environmental awareness and pro-environmental behavior, interprets the main thematic connections, and formulates empirically testable future research priorities. Its contribution lies in distinguishing the descriptive bibliometric patterns from the behavioral mechanisms discussed in the cited studies, while explicitly recognizing limitations in the available search documentation.

Based on the identified research gaps, this systematic literature review aims to answer the following research questions:

1. How has research on environmental awareness and pro-environmental behavior evolved over time?
2. What future research directions can advance environmental awareness and pro-environmental behavior studies?

These research questions are relevant to SDG 12 (responsible consumption and production), because waste reduction and sustainable purchasing require changes in everyday practices, and SDG 13 (climate action), because energy conservation and other low-

carbon behaviors can complement policy and technological responses. The review does not measure progress toward either SDG directly.

2. Methods

This study uses a systematic literature review (SLR) with descriptive publication mapping, keyword co-occurrence visualization, and a narrative comparison of relevant studies. The PRISMA 2020 framework is used to organize the reported screening stages. Because the available manuscript does not contain a complete search log or per-study extraction file, reproducibility and causal inferences must be interpreted within these documentary limits.

Figure 1 reproduces the existing PRISMA flow diagram without changing its quantitative values. The diagram identifies a Scopus search dated 6 October 2026 and reports 161 included records. Its screening and eligibility stages should not be interpreted as an independently audited flow. The diagram does not separately identify Web of Science retrieval or duplicate removal. Accordingly, the 161-record count is attributed to the Scopus-labelled flow shown in Figure 1; any additional Web of Science contribution remains unverified in the provided documentation.

The manuscript identifies Scopus and Web of Science as intended literature sources. However, only the Scopus-labelled screening pathway is quantitatively documented in Figure 1. The diagram displays a keyword sequence built around environmental awareness and pro-environmental or sustainable/green behavior, followed by subject-area, document-type, and eligibility restrictions. The exact executable Scopus and Web of Science search strings (including field codes and Boolean grouping), database-specific retrieval totals, duplicate-removal method and count, and itemized exclusion reasons cannot be reconstructed reliably from the supplied manuscript. These details must be recovered from the original search exports before the review can be described as fully reproducible.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion Criteria	Exclusion Criteria
Publication type	Peer-reviewed journal articles	Conference papers, book chapters, editorials, reviews
Database	Scopus and Web of Science indexed journals	Non-indexed publications
Language	English articles	Non-English articles
Research focus	Studies examining environmental awareness and pro-environmental behavior	Studies unrelated to awareness or environmental behavior
Subject area	Environmental science, sustainability, social science, psychology, management	Unrelated disciplines

The eligibility window was specified as 2010–2026 (Table 1). Figure 2, however, displays annual publications only for 2016–2026. The provided material does not establish whether 2010–2015 had no eligible records or whether those years were omitted from the plotted extract. Therefore, the plotted trend is interpreted strictly for 2016–2026 and no zero counts are inferred for 2010–2015.

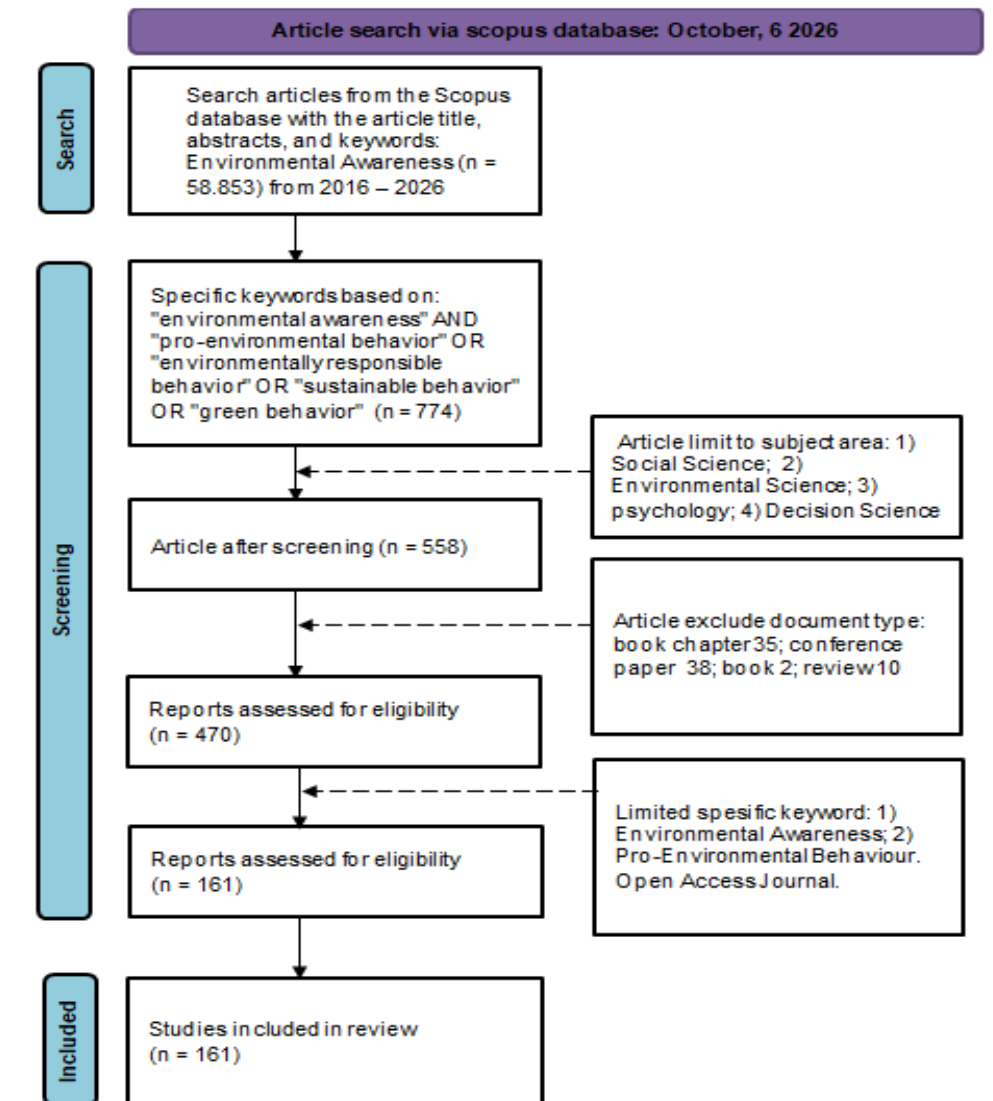


Figure 1. PRISMA screening flow as provided in the original manuscript

3. Results and Discussion

The descriptive results are presented in a consistent sequence: selection flow (Figure 1), annual publication profile (Figure 2), and keyword co-occurrence network (Figure 3). Table 1 summarizes the stated inclusion and exclusion criteria. The existing visuals are retained without alterations. The narrative synthesis that follows discusses the awareness–behavior gap and differentiates associations reported by the cited literature from the thematic links visible in the network.

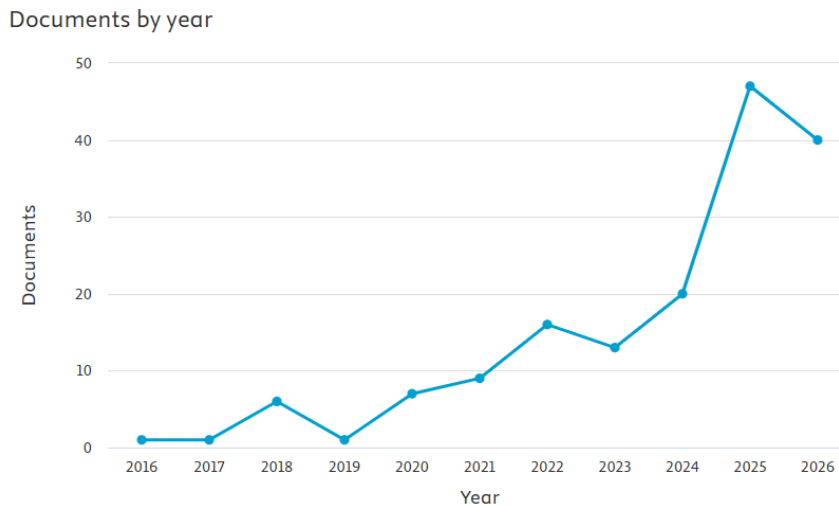


Figure 2. Annual publication trend in environmental awareness and pro-environmental behavior research

As shown in Figure 2, the plotted annual publication counts are relatively low during 2016–2020 and rise later in the displayed period. This observation describes the plotted dataset only and should not be extrapolated to all relevant literature. The inclusion window begins in 2010, but Figure 2 begins in 2016; the absence of plotted points for 2010–2015 is not evidence of zero publications.

The plotted profile rises during 2021–2023, and the highest displayed value is in 2025 (Figure 2). The 2026 point reflects a year that was still incomplete at the search date indicated in Figure 1 (6 October 2026). Consequently, the 2026 count must be treated as partial-year coverage and should not be compared with a full calendar year as evidence of decline.

Possible explanations for greater publication activity include increased interest in climate change, sustainable consumption, environmental education, and behavioral policy. These are plausible contextual interpretations rather than tested explanations for changes in publication counts; Figure 2 alone cannot establish their relative contributions.

Conceptually, research trends indicate a shift from the initial approach of simply measuring an individual's level of environmental awareness to a more complex approach, namely how this awareness can be translated into real behavioral changes. Researchers are beginning to explore the factors influencing the gap between environmental awareness and actual actions (awareness-behavior gap), as individuals with high environmental awareness do not necessarily always demonstrate green behavior in their daily lives.

Recent research also tends to integrate additional variables such as:

- Environmental knowledge → how environmental knowledge influences individual decisions.
- Environmental attitude → the role of attitudes towards environmental concern.
- Social norms → the influence of the social environment on green behavior.
- Green consumption intention → the intention to purchase and use environmentally friendly products.
- Sustainability education → the role of education in shaping sustainable behavior.

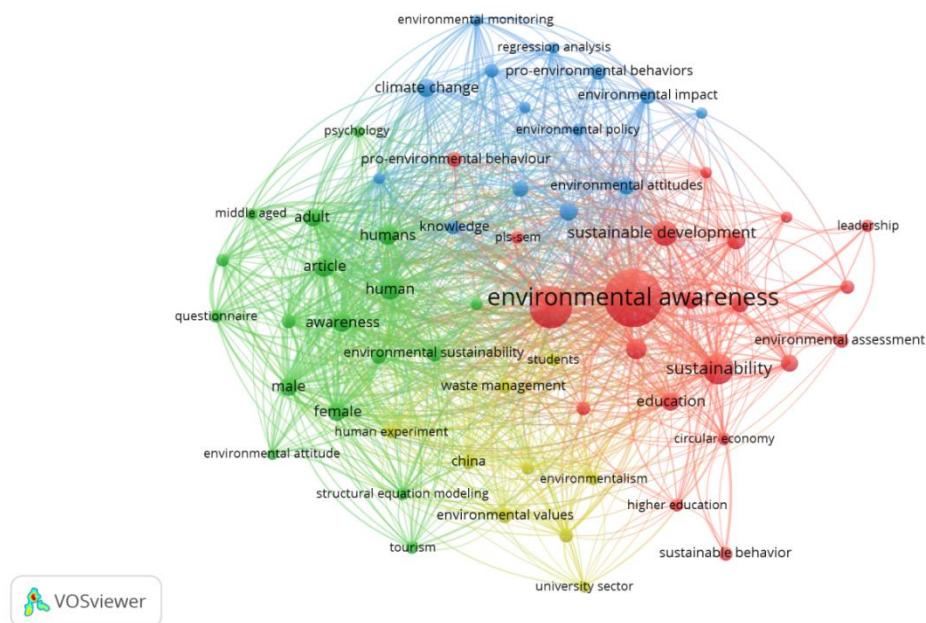


Figure 3. VOSviewer keyword co-occurrence network

Figure 3 visualizes co-occurrence links among keywords in the existing bibliometric output. In this display, node size indicates occurrence prominence, links represent co-occurrence, and colors identify the five visually distinguished clusters. Because the original VOSviewer export and parameter report were not supplied, the counting approach (full or fractional), minimum occurrence threshold, exact number of retained keywords, normalization method, resolution, and clustering settings cannot be verified. The cluster labels below are therefore descriptive interpretations of the visible network, not independently replicated classifications. [AUTHOR VERIFICATION REQUIRED: provide VOSviewer counting method, occurrence threshold, number of included keywords, normalization and clustering settings from the original analysis.]

Cluster 1: Environmental Awareness, Sustainability, and Behavioral Transformation (Red Cluster)

The largest and most central cluster is represented by the red cluster, with "environmental awareness" appearing as the dominant keyword. This indicates that environmental awareness functions as the primary conceptual foundation in the reviewed literature. The strong connection between *environmental awareness*, *sustainability*, *sustainable development*, *environmental attitudes*, *education*, and *sustainable behavior* demonstrates that most studies focus on understanding how awareness contributes to sustainable decision-making and behavioral change.

The strong relationship between environmental awareness and sustainable development indicates that awareness is considered an important foundation for achieving sustainability goals. Studies often examine how awareness influences responsible behaviors, including waste reduction, resource conservation, and environmentally friendly practices. The connection between environmental awareness, attitudes, and sustainable behavior also highlights that awareness alone may not be sufficient, as behavioral change often involves a transition from knowledge and values to actual actions. Keywords such as education, higher education, and leadership further indicate the growing role of institutional interventions in

promoting environmental awareness and sustainable behavior (Gupta et al., 2024; Rugbani et al., 2026).

Cluster 2: Environmental Behavior, Psychology, and Social Factors (Blue Cluster)

The blue cluster represents the behavioral and psychological dimensions of environmental research, highlighting connections among pro-environmental behavior, psychology, environmental attitudes, climate change, and environmental policy. This cluster shows a shift from studying environmental knowledge toward understanding the psychological factors influencing sustainable actions, including beliefs, values, responsibility, perceived control, and social influence. The link between climate change awareness and behavior indicates growing interest in how environmental risks shape public perceptions and responses.

Cluster 3: Human Characteristics, Awareness Measurement, and Research Methods (Green Cluster)

The green cluster represents research on human characteristics, measurement methods, and population-based analysis, with keywords such as human, students, questionnaire, awareness, environmental attitude, and structural equation modeling (SEM). This cluster highlights the use of quantitative surveys to examine environmental awareness, attitudes, and behaviors. SEM is commonly applied to analyze relationships among knowledge, attitudes, intentions, and sustainable practices, while demographic factors are explored to identify differences across population groups.

Cluster 4: Environmental Values, Waste Management, and Sustainable Practices (Yellow Cluster)

The yellow cluster focuses on practical sustainability applications, including environmental values, waste management, environmentalism, and the university sector. This cluster shows how environmental awareness is linked to specific sustainable behaviors, such as waste reduction and recycling, while highlighting the role of ecological values and educational institutions in promoting sustainability.

Cluster 5: Emerging Themes in Sustainable Innovation and Circular Economy (Orange Cluster)

The orange cluster highlights emerging sustainability research, focusing on circular economy, sustainable behavior, environmental assessment, and education. This cluster emphasizes the role of environmental awareness and education in promoting circular practices, responsible consumption, and resource efficiency.

The VOSviewer visualization reveals that research on environmental awareness and pro-environmental behavior has developed into a multidisciplinary field consisting of interconnected psychological, social, educational, and environmental dimensions.

The central position of environmental awareness indicates that it remains the core concept linking different research perspectives. However, the network structure also shows that current research has moved beyond measuring awareness alone and increasingly investigates:

1. The psychological mechanisms behind environmental behavior, including attitudes, values, and motivations.
2. The role of education and institutions in transforming awareness into sustainable practices.
3. The influence of contextual factors, such as environmental policies, social conditions, and accessibility of sustainable alternatives.

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4. The application of sustainability concepts, including waste management and circular economy.

Taken together, Figure 3 suggests thematic proximity among awareness, education, psychological factors, and sustainability applications. Co-occurrence represents shared appearance in bibliographic records; it does not establish that awareness causes behavior or that one construct mediates another. Such explanations require study-level designs and measures, discussed in the following evidence comparison.

3.1. Evolution of Environmental Awareness and Pro-Environmental Behavior Research

The existing manuscript describes a dataset of 161 included articles (Figure 1), while Figure 2 depicts the subset or annual extract displayed for 2016–2026; equivalence of those two datasets remains to be verified. Within the displayed series, the strongest rise occurs after 2024, with a 2025 peak. The figure does not support a complete calendar-year comparison with 2026, which is shown only through the reported October search date.

In the initial research period (2016–2020), studies on environmental awareness and pro-environmental behavior were still in their early stages of development. The relatively low number of publications indicates that research during that period focused primarily on understanding the basic concepts of how individuals develop awareness of environmental issues and how this awareness relates to daily behavior. The primary focus of research during this period was to identify whether a person's level of environmental knowledge and concern could be a driving factor in behaviors such as energy conservation, reducing plastic use, waste management, and consuming more environmentally friendly products.

However, early research found a phenomenon known as the environmental awareness-behavior gap, a condition where someone has a high level of environmental awareness but does not necessarily implement appropriate behavior in real life. For example, someone may understand the negative impact of plastic waste on the environment, but still use single-use plastic products due to convenience, price, or limited availability of environmentally friendly alternatives. These findings then prompted the development of research in a more complex direction, namely not only measuring levels of environmental awareness but also understanding the factors that can bridge the transition from awareness to concrete action (Benzehaf et al., 2025; Colombo et al., 2023).

Entering the 2021–2023 period, research began to experience broader conceptual developments. At this stage, researchers began to move away from the simplistic approach of only looking at the direct relationship between environmental awareness and environmental behavior. Instead, research began to incorporate various psychological, social, and situational variables thought to influence individual decisions to engage in sustainable behavior.

Some of the variables increasingly studied include:

- a. Environmental attitude, which is how a person evaluates the importance of environmental protection.
- b. Environmental concern, which is an individual's level of concern about environmental problems.
- c. Environmental knowledge, which is a person's understanding of environmental issues and solutions.
- d. Social norms, which is the influence of the social environment on a person's decisions.

e. Perceived behavioral control, which is an individual's perception of the ability and ease of engaging in environmentally friendly actions.

These developments indicate that environmental behavior is beginning to be understood as a multidimensional phenomenon. This means that a person not only engages in green behavior because of knowledge or awareness, but is also influenced by external factors such as social support, government policies, the availability of facilities, economic conditions, and community culture.

Context-specific accounts in the supplied reference list span university sustainability engagement, higher education institutions, office-administration students, and environmental education (Benzehaf et al., 2025; Gupta et al., 2024; Rugbani et al., 2026; Subarno et al., 2026). Other cited studies consider psychological determinants, ecological paradigms, and responsible behavior in distinct populations (Lin et al., 2026; Smadi & Al Rawwad, 2026; Suryani & Ali, 2026). These works should not be treated as methodologically equivalent without study-level appraisal.

The figure shows a pronounced rise during the displayed 2024–2026 interval, peaking in 2025. Because the 2026 observations cover only part of that year, a lower plotted 2026 total should not be framed as a sustained reversal. The underlying plotted totals are preserved and no additional publication counts have been calculated or inserted.

The increased research attention after 2024 can be attributed to the increasing urgency of various global environmental issues, such as climate change, rising carbon emissions, ecosystem degradation, environmental pollution, and increasing pressure on natural resources. These issues have prompted academics to understand how changing human behavior can be a strategy for achieving the Sustainable Development Goals (SDGs), particularly those related to sustainable consumption and production, climate action, and ecosystem protection.

In this latest phase, the direction of research has undergone a paradigm shift. While previous research focused primarily on the question: *"How high is a person's level of environmental awareness?"*, recent research has begun to focus on a more applicable question: *"How can we build a system capable of transforming environmental awareness into consistently sustainable behavior?"*. This shift in focus has led to the emergence of various new approaches to research. For example, research has begun to explore how environmental education can increase green behavior among students and young people, how environmental communication strategies can influence consumer decisions, and how public policy can create conditions that support communities to adopt environmentally friendly practices.

Furthermore, developments in digital technology have also begun to become part of the study of pro-environmental behavior. Social media, digital applications, technology-based environmental campaigns, and the dissemination of information through digital platforms are beginning to be studied as instruments that can raise awareness and encourage behavioral change in society. This demonstrates that recent research not only views individuals as environmental actors but also considers the role of social and technological systems in shaping sustainable behavior.

Recent bibliometric work also provides a complementary view of field-level topic development rather than a direct test of the awareness–behavior pathway (Kayhalak & Karaküçük, 2026; Wang et al., 2025).

Overall, the publication profile and five-cluster network support a descriptive account of increasing visibility and multidisciplinary in the examined literature, but they do not establish the prevalence of particular behavioral mechanisms across all studies. A more targeted comparison of the cited empirical work is needed to distinguish contextual similarities, differences, and limits of interpretation.

3.1.1. Evidence-based comparison of behavioral mechanisms

Across educational settings, Fu et al. (2017), Carducci et al. (2021), and Zhang and Cao (2025) address awareness or knowledge alongside attitudes, self-efficacy, and environmental practices; the common implication is that cognitive knowledge should not be treated as a sufficient stand-alone explanation of behavior. Colombo et al. (2023) explicitly discusses the knowledge-action gap, whereas Wyss et al. (2022) focuses on the contingent role of costs, benefits, and self-control. These contributions converge in questioning a simple awareness-to-action pathway, but they differ in the psychological and situational mechanisms they emphasize.

Studies of other settings add contextual differentiation. Omarova and Jo (2022) investigate workplace leadership and green human-resource management; Savari et al. (2023) link normative and planned-behavior perspectives to farmers' intentions; Liobikienė and Poškus (2019) distinguish private- and public-sphere environmental behavior; and Plohl et al. (2026) examine subjective norms and self-efficacy. Thus, organizational support, moral norms, perceived capability, behavioral domain, and perceived costs are candidate mediators or moderators to test, not uniformly established effects across all contexts. Because the provided review lacks harmonized effect sizes, instruments, and quality ratings, this comparison identifies conceptual convergence and differences in emphasis rather than ranking empirical effect magnitudes.

Evidence-comparison summary: education/student contexts – attitudes, self-efficacy, and knowledge-action discrepancies (Fu et al., 2017; Carducci et al., 2021; Zhang & Cao, 2025); consumption and individual action – costs, benefits, self-control, and behavioral sphere (Wyss et al., 2022; Liobikienė & Poškus, 2019); workplaces – leadership and institutional support (Omarova & Jo, 2022); agriculture – intention, moral norms, and perceived behavioral control (Savari et al., 2023). The cited studies do not supply a single pooled estimate, and the original manuscript does not provide the extraction data needed for one.

3.2. Future Research Directions

The following agenda separates immediate, falsifiable tests from longer-term methodological and contextual extensions. Proposed mechanisms are hypotheses for future evaluation, not causal conclusions drawn from the co-occurrence map.

3.2.1. Moving Beyond the Awareness-Behavior Gap

Immediate priority 1 – test the awareness-behavior gap prospectively. Research question: Among individuals with comparable awareness, do perceived cost, convenience, and access predict verified recycling frequency, single-use-plastic avoidance, or household energy use? Longitudinal observations and intervention studies should measure behavior rather than relying exclusively on stated intentions. Differences by income, education, and

infrastructure should be prespecified as possible moderators (Colombo et al., 2023; Wyss et al., 2022).

3.2.2. Developing Integrated Theoretical Models

Immediate priority 2—compare integrated models using observable outcomes. Research question: Does combining TPB constructs (attitude, subjective norm, perceived behavioral control) with VBN/NAM constructs (values, awareness of consequences, ascription of responsibility, personal norm) improve prediction of measured waste sorting, sustainable purchasing, or energy-saving behavior compared with either framework alone? Model comparisons should use preregistered hypotheses and held-out validation where feasible (Liobikienė & Poškus, 2019; Savari et al., 2023; Wei et al., 2026).

TPB emphasizes rational processes, including attitudes, subjective norms, and perceived behavioral control. However, environmental behavior is also shaped by personal values, moral obligations, and emotional connections with nature. In contrast, VBN and NAM focus on moral motivations and environmental responsibility but may not adequately address practical barriers, such as financial constraints or limited behavioral control (Savari et al., 2023; Wang et al., 2025).

An explicit testable pathway is proposed: environmental awareness and values may inform attitudes and responsibility; personal norms and perceived behavioral control may then influence intentions, while access and transaction costs can moderate the intention-to-action relationship. Competing mediation paths should be compared with repeated behavioral observations. Claims of mediation or moderation should be restricted to studies designed to evaluate them.

3.2.3. Expanding Research Contexts

Medium-term priority—test transportability across settings and populations. Replicate the same behavioral outcome and validated constructs in university, household, workplace, and agricultural settings, including developing economies. Evaluate measurement invariance before interpreting between-group differences. The present review does not provide a geographical frequency table, so geographical imbalances should be verified rather than assumed.

3.2.4. Increasing Methodological Diversity

Medium-term priority—reduce design-dependent uncertainty. Cross-sectional associations should be complemented with prospective cohorts, randomized or quasi-experimental interventions, unobtrusive behavior measures, and qualitative process studies. Predefine follow-up windows and report attrition, measurement reliability, and alternative explanations.

Future research should adopt more diverse methods, including (1) longitudinal studies to examine long-term behavioral changes, (2) experimental designs to establish causal relationships, (3) behavioral observation to measure actual environmental practices, and (4) mixed-method approaches to combine statistical findings with deeper insights into behavioral motivations. These approaches can strengthen research evidence and provide a more comprehensive understanding of pro-environmental behavior.

3.2.5. Exploring Digital Environmental Awareness

Longer-term priority – test digitally delivered interventions. Compare appropriately controlled social-media, mobile-learning, or AI-assisted environmental education with non-digital alternatives using observable actions such as sorting accuracy, reuse frequency, and measured resource consumption. Assess engagement, sustained behavior, accessibility, and privacy alongside knowledge gains; digital effectiveness should not be assumed from exposure or online engagement alone.

Digital learning platforms and AI-based systems may support personalized environmental education and sustainable practices. However, studies should also consider ethical issues, including data privacy and unequal digital access. This research direction can clarify how digital technologies influence environmental literacy and long-term pro-environmental behavior.

In order of priority, future studies should first establish whether combined psychological and contextual constructs explain measured behavior, next test robustness across settings and longitudinal designs, and finally evaluate scalable interventions. This agenda supports SDG 12 and SDG 13 conceptually, without implying that the current review has estimated SDG-level impacts.

Conclusions

Research question 1: Within the annual series displayed in Figure 2, publications on environmental awareness and pro-environmental behavior rise markedly after 2024 and reach the displayed maximum in 2025; the 2026 value is partial-year and data for 2010–2015 cannot be inferred from that figure. Figure 3 displays five interconnected thematic clusters, but keyword co-occurrence cannot demonstrate causality. Research question 2: The evidence comparison supports prioritizing prospective tests of the awareness–behavior gap, explicit integration of TPB, VBN, and NAM constructs, observed behavioral outcomes, context-sensitive replication, and longitudinal or experimental approaches. These implications are bounded by the available documentation: exact database-specific searches, deduplication, some screening details, and VOSviewer settings require author verification. The findings are relevant to behavioral contributions to SDG 12 and SDG 13 but do not measure progress toward those goals.

Conflicts of Interest

The authors declare no conflict of interest.

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