

What drives sustainable consumption behavior? Empirical evidence from a three-stage hybrid analysis incorporating bibliometric, PLS-SEM, and NCA evidence

Bilal Mukhtar^{a,*}, Ali Hussain^b, Linda D. Hollebeek^{c,d,e,f,g}, Denni Arli^a

^a Tasmanian School of Business and Economics, University of Tasmania, Tasmania, Australia

^b Hertfordshire Business School, University of Hertfordshire, Hatfield, UK

^c Sunway Business School, Sunway University, Petaling Jaya, Malaysia

^d Vilnius University, Vilnius, Lithuania

^e Tallinn University of Technology, Tallinn, Estonia

^f Umea University, Umea, Sweden

^g University of Johannesburg, Johannesburg, South Africa

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ABSTRACT

Promoting sustainable consumption behavior (SCB) is key among the U.N.'s Sustainable Development Goals. However, due to inconsistent findings, understanding of how to promote these behaviors at the individual level lags behind, revealing an important gap. To address this gap, we adopt a multi-method approach. We first review the literature to identify and test key individual-level drivers of sustainable consumption behavior using bibliometrics (R-studio) with thematic mapping and three field plots (study 1). Extending study 1, study 2 draws on value-belief-norm theory to test the effect of religiosity, climate change anxiety, and pro-environmental knowledge on SCB, alongside the moderating role of psychological ownership ($n = 294$). To analyze the data, we adopt partial least-squares structural equation modeling (PLS-SEM) and necessary condition analysis (NCA). The SEM findings indicate a positive effect of religiosity, climate change anxiety, and pro-environmental knowledge on SCB. The results also suggest that psychological ownership positively moderates the impact of pro-environmental knowledge on SCB. The NCA results suggest that climate change anxiety is a progressively binding constraint, whereas religiosity and pro-environmental knowledge are also necessary conditions but function as baseline enablers in shaping SCB. Overall, this research offers novel understanding of how specific cognitive and moral factors contribute to SCB, raising pertinent implications for marketers and policymakers.

1. Introduction

As over-exploitation is rapidly depleting life-sustaining resources worldwide, sustainable consumption has become a major focus for academicians, managers, and policymakers (Dahrouj et al., 2025). According to a recent United Nations (2024) report, the global population is projected to reach 9.6 billion by 2050, implying that nearly three planets would be required to sustain current lifestyles. To address this issue, promoting *sustainable consumption behavior* (SCB), “practices that reduce adverse environmental impacts and natural resource consumption across a product's lifecycle, behavior or service” (White et al., 2019), is pivotal, as acknowledged in the U.N.'s (2026) 12th Sustainable

Development Goal (SDG) on *Responsible Production and Consumption*.

However, while approximately 20% of Fortune 500 companies cite the SDGs in their sustainability communications, only 0.2% explicitly report measurable progress in this regard Song et al. (2022), raising potential *greenwashing* concerns. Likewise, though 67% of consumers express a willingness to pay more for sustainable goods, only 7% of shoppers actually adopt sustainable consumption practices (Nadeem et al., 2025). Therefore, despite stakeholders' rising willingness to act in sustainable ways, their actual sustainable behavior lags behind to date Qadri et al. (2026), revealing a core literature-based tension.

Addressing this tension, prior authors have adopted myriad perspectives and methods to investigate SCB (see Table 1), which has

* Corresponding author.

E-mail addresses: bilal.mukhtar@utas.edu.au (B. Mukhtar), alihussain.08@hotmail.com (A. Hussain), lindah@sunway.edu.my (L.D. Hollebeek), denni.arli@utas.edu.au (D. Arli).

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however incurred a level of theoretical fragmentation and potentially incompatible findings. For example, while [Gandhi et al. \(2025\)](#) explore SCB using the theory of planned behavior, [Lavuri et al. \(2023\)](#) employ stimulus-organism-response theory, raising possible theoretical inconsistencies and/or irreconcilable issues, which warrant clarification.

Therefore, further advancing understanding of SCB and its key drivers represents a core literature-based priority ([Elhoushy and Jang, 2023](#)), as addressed in this research through a bibliometric review of the SCB discourse (study 1: $n = 433$ business/marketing articles). Study 1 seeks answers to the following research question: *What is the nature of the key theoretical associations of SCB in its nomological network?* The findings suggest three main drivers of SCB, including consumer (i) *religiosity*, the extent to which an individual's moral compass guides their consumption behavior (e.g., through perceived spiritual obligations/norms; [Minton et al., 2018](#)), (ii) *climate change anxiety*, the extent of their worry, fear, and emotional distress about the consequences of climate disruption ([Nguyen et al., 2025](#)), and (iii) *pro-environmental knowledge*, the extent to which consumers are familiar with, and have the cognitive tools to make sustainable consumption choices ([Trinh et al., 2025](#)).

As most SCB research has focused on developed countries, specific (e.g., cultural) traits may be over-represented in this corpus of literature (see [Fig. 1](#)), revealing a related gap. Therefore, a need exists to further examine the role of consumer religiosity, climate change anxiety, and pro-environmental knowledge in developing (vs. developed) nations that are characterized by distinct socio-cultural traits ([Kumar et al., 2025](#)). While developing nations tend to have fewer resources to engage in SCB, interest in sustainability is rising in this context ([Al Amin et al., 2025](#)), warranting further exploration. Accordingly, we draw on value-belief norm theory [Stern \(2002\)](#) to empirically test the study 1 findings in the developing market context.

Overall, this research makes two main contributions to SCB and the

literature on developing markets. Study 1 first maps the evolutionary path of the SCB literature by quantifying, aggregating, and analyzing key SCB articles and their themes [Braam et al. \(1991\)](#), permitting assessment of its intellectual structure and helping to address the rising theoretical fragmentation in this literature stream. We uncover the key SCB themes of consumer religiosity, climate change anxiety, and pro-environmental knowledge, which serve as important inputs for study 2.

Second, drawing on value-belief-norm theory, study 2 empirically tests the study 1 findings through a model that incorporates consumer religiosity, climate change anxiety, and pro-environmental knowledge as core SCB antecedents, using PLS-SEM and NCA. While prior research has explored the role of these variables individually ([Goswami et al., 2025](#); [Nguyen et al., 2025](#); [Rustam et al., 2020](#)), acumen of their combined effect on SCB lags behind, as therefore explored in study 2. Moreover, using necessary condition analysis (NCA), the findings suggest that CCA acts as a progressively binding constraint, whereas PEK and CR function as baseline enablers in shaping SCB [Dul et al. \(2023\)](#), revealing the core strategic role of each of these ([Richter et al., 2020](#)). Overall, the adopted mixed-method research approach helps advance individual-level acumen of SCB in the developing market context. This is important, given key individual differences in SCB, thereby raising pertinent implications for managers ([Winterich et al., 2024](#)).

2. Study 1: bibliometric analysis - sustainable consumption behavior

2.1. Search protocol

We conducted a bibliometric analysis using the widely-used PRISMA approach to better understand the intellectual structure of SCB research

Table 1
Selected prior SCB research.

Authors	SCB Antecedents	Theoretical Foundation	Method	Main Findings	Country
Trinh et al. (2025)	Environmental Knowledge and perceived environmental responsibility	Norm activation theory	Surveys	environmental knowledge indirectly influences sustainable consumption behavior through perceived environmental responsibility	Vietnam
Gandhi et al. (2025)	Purchase intentions, perceived behavioral control, education, marital status, and gender	Theory of planned behavior	Surveys	Purchase intentions and marital status positively influence SCB, while gender has a negative association. Perceived behavioral control and education show no significant impact.	India
Barone et al. (2024)	Attitudes, subjective norms, perceived behavioral control, anticipated emotions, and habits	-	Surveys	Attitudes, subjective norms, perceived behavioral control, anticipated emotions, and habits are all significant predictors of the desire to adopt sustainable consumption behavior	Italy
Tan and Ota (2024)	Perceived convenience, perceived savings, and self-efficacy	Theory of planned behavior; Bandura's social-cognitive theory	Surveys	Self-efficacy and perceived convenience positively influenced SCB.	Japan
Barrera-Verdugo and Durán-Sandoval (2024)	Moral reasoning, environmental concern	Theory of planned behavior	Surveys	Moral reasoning and environmental concern positively impact sustainable consumption behaviors	Chile
Yang et al. (2023)	Green cooperation and trust	Contingency theory; trust theory	Surveys	Green cooperation and trust significantly and positively associated with SCB.	South Korea
Tong et al. (2023)	Pro-environmental personal attitudes and pro-environmental social norms, opportunity, ability, and sustainable consumption intention	Theory of planned behavior; Social comparison theory	Surveys	Motivation, opportunity, intentions and ability are significant facilitators of sustainable consumption behavior.	China
Lavuri et al. (2023)	Egoistic values, altruistic values, and social consumption motivation	Stimulus-organism-response theory	Surveys	Egoistic, altruistic values and social consumption motivation had a positive influence on SCB.	India
Dong et al. (2018)	Consumer needs (need for autonomy, need for affiliation, and need for control) and material possession.	Self-determination theory	Surveys	Consumers' needs for autonomy, affiliation, and control significantly influence their love for material possessions, thereby affecting their sustainable consumption behavior.	China
Watkins et al. (2016)	Liberal political orientation	-	Surveys	people with individualizing moral foundations, who tend to the political left, are more likely to engage in sustainable consumption behavior.	New Zealand
Dermody et al. (2015)	Materialism, social consumption motivation, environmental concerns, and environmental self-identity	-	Surveys	Materialism and environmental concerns show no significant effect on sustainable consumption behavior, while social consumption motivation and environmental self-identity have a positive impact.	United Kingdom

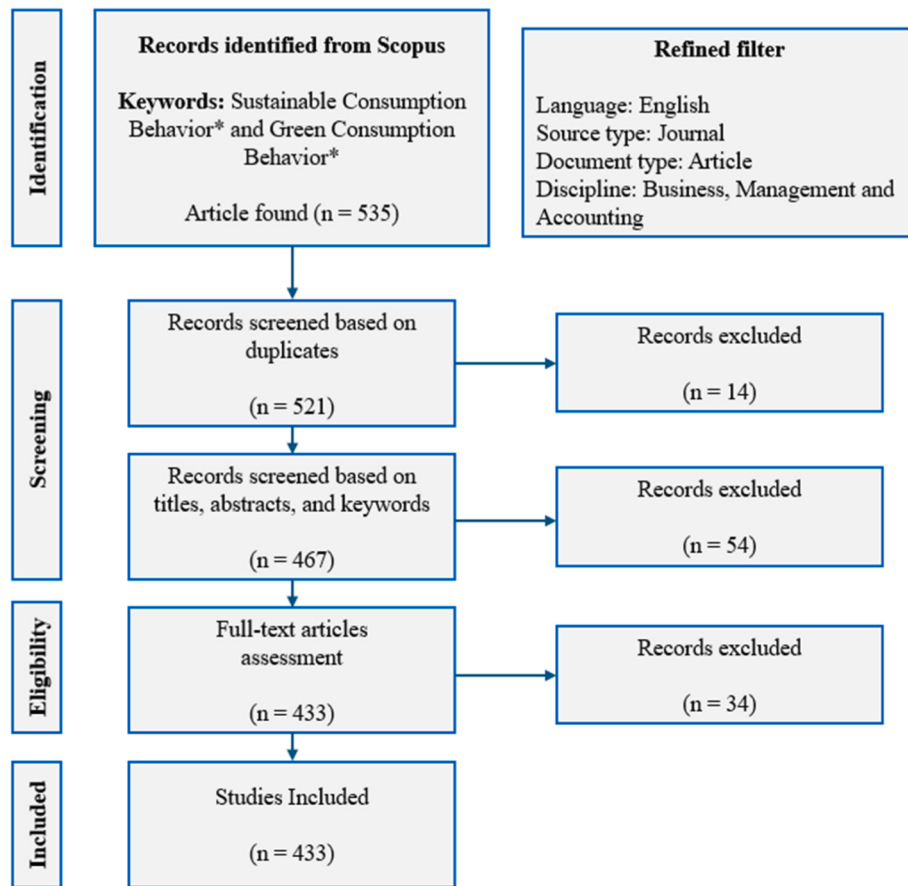


Fig. 1. Prisma framework for article section.

(Liberati et al., 2009). Following PRISMA guidelines, the article selection process comprised four stages: Identification, Screening, Eligibility, and Inclusion. Following Chiarini et al. (2013), we used the Scopus database to select relevant articles with the following keywords in the article titles, abstracts, and keywords: Sustainable Consumption Behavior* and Green Consumption Behavior*. We included articles in English from Business, Management/Accounting journals, returning a total of 535 articles.

2.2. Exclusion criteria

Following Paul et al. (2021), we screened the articles (Watson (2002), which commenced with the removal of duplicate records, yielding the exclusion of 14 articles. We then reviewed the remaining 521 articles and their title, abstract, and keywords, yielding the exclusion of 54 irrelevant articles. In the third step (Eligibility), the remaining 467 articles underwent full-text screening, resulting in the exclusion of a further 34 articles. The screening process narrowed the dataset to a final set of 433 articles, which were entered in the fourth analytical step, Inclusion (see Fig. 1; (Behera and Kumra, 2023). The final dataset comprises articles published from 2002 to 2025. The articles appeared in 168 journals, indicating the interdisciplinarity of SCB research, including its important intersection with marketing.

2.3. Bibliometric analysis

Using R-studio, we systematically and quantitatively examine the SCB literature through bibliometric analysis (Alwani and Bhukya, 2025). Bibliometric analysis leverages bibliographic data from databases to map the intellectual structure of a scientific field, including by using thematic mapping and Sankey diagrams, three-field plots (Sharma

et al., 2024). While thematic maps classify keywords into themes based on their relevance and interconnections, highlighting critical areas for further investigation, Sankey diagrams visually depict the flow and relationships across fields, illustrating the distribution and connectedness of relevant dimensions (e.g., key themes/journals).

2.3.1. Thematic mapping

Using thematic mapping (see Fig. 2), SCB research was classified into basic, emerging and declining, motor, and niche themes (Mukhtar et al., 2024). First, two main nodes were identified in the basic themes, including a node containing (i) foundational keywords like “sustainable consumption,” “green consumption,” and “sustainable development,” which highlight a focus on environmentally-responsible consumption and its alignment with sustainability goals; and (ii) the “theory of planned behavior,” “circular economy,” and “green purchase behavior,” which emphasizes theory and actionable behavior in the sustainability context.

Second, emerging/declining themes are denoted by single node, covering keywords like “sustainability,” “consumer behavior,” and “consumption.” This theme reflects broad behavioral notions that may see a shifting or evolving focus (e.g., toward more sustainable consumption). These terms capture the dynamic interplay between sustainability objectives and individual consumer actions, which (in the case of our analysis) represent a growing theme.

Third, the motor theme is represented by one node that comprises keywords including “environmental concern,” “environmental knowledge,” and “green attitude.” These terms signify driving forces in the field, which act as a catalyst in advancing SCB. They emphasize the role of consumer awareness, education, and positive attitudes toward environmental issues. Finally, the niche theme includes a single node with keywords like “green behavior,” “green consumption behavior,” and

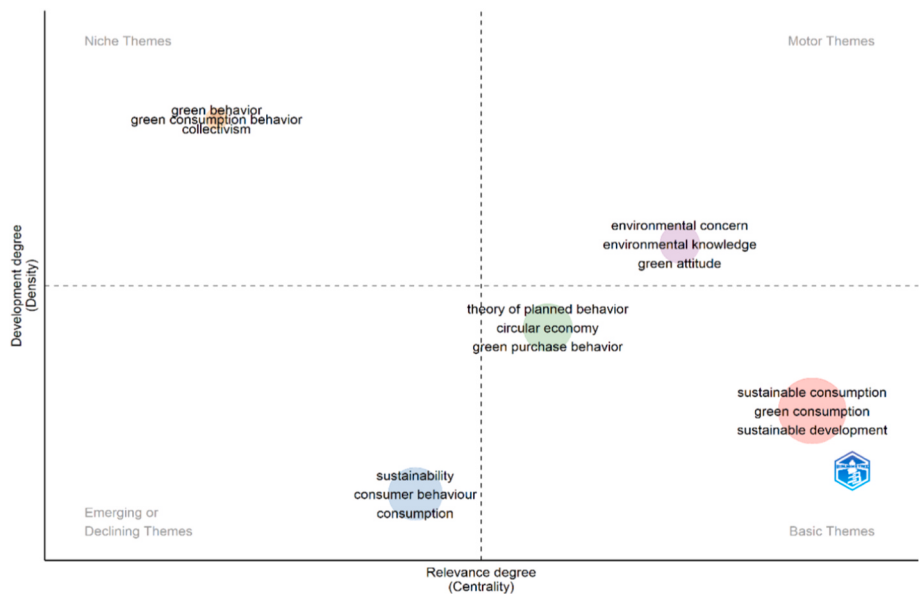


Fig. 2. Thematic mapping.

“collectivism.” This theme focuses on specialized research areas that are highly developed but narrowly focused. The inclusion of “collectivism” points to cultural or societal influences on SCB, advising an exploration of collective actions and shared responsibilities in promoting SCB.

2.3.2. Sankey Diagram

The connections between the leading countries of published SCB research (left), sources (middle), and defined keywords are analyzed using a Sankey plot to examine which keywords are most relevant to specific countries publishing on SCB (Khan et al., 2024). This visualization was used to define relationships across the three main areas of SCB (i.e., restate the 3), with the plot highlighting the relative proportions and connections among the nodes.

In the Sankey plot, rectangular shapes represent key elements, with different colors and sizes reflecting the strength and prevalence of connections between components. The size of the rectangles is not constant, as they dynamically adjust based on the relationships depicted between the elements. As illustrated in Fig. 3, the Sankey plot reveals that such keywords as “sustainable consumption,” “sustainability,” “green consumption,” “sustainable development,” “green products,” and “green marketing” are primarily associated with high-impact sources, including the *Journal of Cleaner Production*, *Business Strategy and the*

Environment, *Journal of Retailing and Consumer Services*, *Journal of Sustainable Tourism*, and *Technological Forecasting and Social Change*. These keywords and journals also demonstrate strong connections with leading countries, including China, Canada, Portugal, the U.S.A., Korea, and Germany, indicating a concentrated global effort in these regions to advance the discourse on SCB.

3. Study 2

3.1. Theoretical framework and hypothesis development

3.1.1. Theoretical framework

Value-belief-norm theory, which suggests that personal values, beliefs, and moral norms lead to behavior Stern (2002), offers a compelling lens through which to examine the psychological and normative mechanisms underpinning SCBs (Lima et al., 2023). The theory posits a causal chain starting with consumer values that shape their beliefs (e.g., about environmental threats) to then activate their personal norms guiding their pro-environmental actions (Nguyen and Dekhili, 2024). In the model, consumer religiosity reflects consumer values, while climate change anxiety and pro-environmental knowledge capture the belief component of the theory. Moreover, psychological ownership, the sense

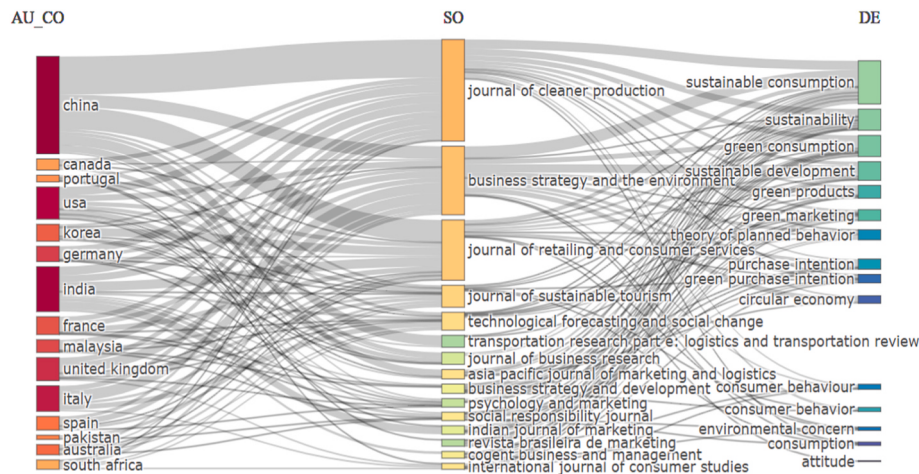


Fig. 3. Sankey diagram (biblioshiny): AU_CO authors ‘country, SO: Source, and DE: Defined keywords.

that “environment[al] outcomes are mine to protect” [Felix and Almaguer \(2019\)](#), reflects consumers’ personal norm, while SCB represents their behavioral outcome.

Consumer religiosity is a deeply internalized value orientation that sanctifies environmental stewardship and implants moral concern. Religiosity thus elevates biospheric and altruistic value priorities, raising awareness of environmental consequences and the ascription of personal responsibility, triggering norm activation ([Minton et al., 2016](#)). Prior evidence that religiosity activates personal norms and strengthens pro-environmental action supports this value-belief-norm cascade ([Ghazali et al. \(2019\)](#)), particularly in collectivist contexts where religious values tend to organize identity and obligation.

Religiosity also increases consumer receptivity to environmental information and ethical messages, positioning it as a catalyst for belief formation, including the acquisition and acceptance of pro-environmental knowledge that subsequently supports norm activation ([Bhuiyan et al., 2018](#)). Relatedly, [Chung et al. \(2019\)](#) report that religious fundamentalism positively influences pro-environmental behavior through biospheric altruism, reinforcing the notion that spiritual values can boost environmental concerns.

From a value-belief-norm perspective, consumers’ climate change anxiety is a belief-oriented construct that reflects consumers’ awareness of environmental threats and personal vulnerability. In the theory, such appraisals intensify awareness of consequences and strengthen responsibility attributions that are central to personal norm activation ([Bouman et al., 2020](#)). When anxiety is functional (vs. petrifying), it mobilizes information-seeking and problem-focused coping, increasing pro-environmental knowledge and the perceived need to act ([Tusyanah et al., 2024](#)). This process converts concern into obligation, an affective route to norm stimulation that is consistent with evidence that beliefs about environmental degradation and personal responsibility are pivotal for behavioral change ([Guglielmi et al., 2016](#)). Importantly, religiosity and anxiety are mutually reinforcing in this chain: Religious stewardship narratives frame anxiety as being morally relevant, channeling it into constructive coping (learning/ethical purchasing) and raising the likelihood of the emotional response to translate into knowledge and norms (vs. avoidance). Therefore, religiosity offers moral meaning and channels anxiety, amplifying its impact on knowledge acquisition and norm activation.

While we treat pro-environmental knowledge as a belief component that strengthens perceived efficacy and clarifies the consequences of specific consumption choices, knowledge is not a passive stock of facts. Rather, it represents a process facilitator that converts value and emotion-driven attention into actionable understanding [Canlas et al. \(2022\)](#) specifying what to do/why it matters; [Canlas et al., 2022](#)), supporting personal norm activation and behavior ([Liobikienė and Poškus, 2019](#)). In the framework, knowledge is both an outcome of religiosity and climate anxiety and a predictor of SCB, consistent with the adopted belief-to-norm-to-behavior cascade.

Moreover, *psychological ownership*, the sense that “environment[al] outcomes are mine to protect,” is a personal norm that moralizes responsibility and fosters stewardship ([Felix and Almaguer, 2019](#)). We specify psychological ownership as a moderator of the knowledge-behavior path: When individuals feel they have a personal stake, their knowledge becomes relevant and is more likely to be enacted. When psychological ownership is low, even well-formed knowledge can remain inactive. The proposed moderating role aligns with evidence that psychological ownership heightens accountability and emotional investment, strengthening pro-environmental intentions and actions ([Wang et al. \(2023\)](#)), extending the theory by introducing identity-linked stewardship as a proximal normative lever that converts beliefs into observable consumption choices ([Hartmann et al., 2018](#)).

Taken together, the framework specifies a concise, testable chain. Religiosity (value) elevates moral responsibility, increasing openness to and pursuit of pro-environmental knowledge and shaping the appraisal of climate risks. Climate change anxiety (belief) motivates information-

seeking and urgency, further augmenting knowledge and the perceived need to act. Pro-environmental knowledge (belief) clarifies efficacy and consequences, while psychological ownership (norm) anchors responsibility and strengthens the translation of knowledge into SCB. Finally, SCB (behavior) reflects a deliberate choice to minimize environmental impact ([Lee et al., 2023](#); [Vighnesh et al., 2022](#)). By integrating personal values and affective appraisals as antecedents to belief formation and by specifying a norm-based moderator that closes the knowledge-behavior gap, this extension addresses prior critiques of under-specified value-belief-norm mechanisms and enhances its explanatory power for SCB ([Landon et al., 2018](#)).

3.1.2. Hypothesis development

Consumer Religiosity and Pro-Environmental Knowledge. Consumer religiosity incorporates beliefs, rituals, and moral principles that guide cognition and behavior ([Filimonau et al., 2022](#)). Many religious traditions attribute ethical imperatives (e.g., stewardship) to creation, aligning, conceptually, with environmental consciousness ([Mortimer et al., 2020](#)). These principles suggest a potential link between religiosity and ecological awareness. However, prior research indicates that religious affiliation alone does not guarantee environmental knowledge. Rather, the internalization of spiritual teachings appears to be a critical driver ([Mo et al., 2022](#)). This distinction highlights an important gap: While normative frameworks exist within religions, the extent to which they translate into active knowledge-seeking remains largely unknown.

Pro-environmental knowledge refers to an individual’s cognitive understanding of environmental issues, their causes, and possible solutions ([Farrukh et al., 2022](#)). It is widely recognized as a prerequisite for SCB. Theoretically, moral philosophy and behavioral frameworks suggest that religious doctrines can serve as normative guides, framing environmental engagement as a spiritual obligation rather than a mere civic duty ([Hwang, 2018](#)). For example, Christianity’s notion of “caretaking of the Earth,” Buddhism’s emphasis on harmony, and Islam’s concept of Khalifah (vicegerency) converge on the principle of stewardship, which may foster epistemic curiosity and motivate individuals to acquire environmental knowledge ([Kala and Chaubey, 2023](#)). However, prior literature often assumes this link without examining whether religiosity translates into consumers’ concrete cognitive engagement with environmental issues. Empirically, [Raggiotto et al. \(2018\)](#) suggest that intrinsic religiosity, where spiritual commitment is deeply internalized, enhances the motivation to understand environmental concerns. Similarly, [El Jurdi et al. \(2016\)](#) report that religiosity strengthens perceived behavioral control, indirectly influencing intentions to acquire environmental knowledge. However, these studies focus on motivational aspects (vs. actual knowledge acquisition processes), largely remaining the dark about the strength and consistency of this relationship and warranting further examination of the effect of religiosity on pro-environmental knowledge. We propose:

H1. Consumer religiosity boosts their pro-environmental knowledge.

Climate Change Anxiety and Pro-Environmental Knowledge. Climate change anxiety, persistent worry and emotional distress about climate-related risks, has emerged as a significant psychological construct ([Clayton and Karazsia, 2020](#)). Unlike general environmental concerns, it reflects a heightened affective engagement with existential threats ([Hollebeek et al., 2023](#)), stimulating proactive (e.g., information-seeking) behavior ([Kumar et al., 2025b](#)). Therefore, emotions are not merely reactive but can function as cognitive catalysts ([Zhou and Ding \(2023\)](#)).

Emotions arise from evaluations of relevance and urgency, conditions that are particularly significant in the climate change context. While empirical evidence supports this linkage, it remains fragmented. For instance, [Agoston et al. \(2024\)](#) found that individuals experiencing climate-related anxiety perceive environmental issues as immediate and personally consequential, fostering their active engagement and information-seeking. Similarly ([Jorgenson et al., 2019](#)), report that

heightened climate concern correlates with greater environmental literacy, suggesting that anxiety can act as a motivational driver. However, as these studies widely rely on cross-sectional designs, causal inference remains limited.

Pavani et al. (2023) highlight a reciprocal dynamic: While anxiety can stimulate knowledge acquisition, increased knowledge may also mitigate anxiety by enhancing perceived control. This feedback loop complicates the directionality of the relationship, raising questions about whether anxiety consistently predicts knowledge or whether the effect may differ across (e.g., cultural/demographic) contexts. Therefore, prior studies often conflate anxiety with general environmental attitudes, leaving uncertainty about its unique cognitive impact. We hypothesize:

H2. Consumers' climate change anxiety boosts their pro-environmental knowledge.

Pro-Environmental Knowledge and Sustainable Consumption Behavior. SCB, the conscious adoption of consumption patterns that reduce environmental degradation, conserve natural resources, and promote social equity Gandhi et al. (2025), is intrinsically shaped by an individual's level of knowledge and understanding of environmental issues (Pothitou et al., 2016). While attitudes and intentions matter, knowledge is often considered as the cognitive foundation for translating environmental concern into concrete action. Rather than serving as a passive repository of facts, pro-environmental knowledge offers cognitive support that enables individuals to critically evaluate the environmental consequences of their consumption choices (Mendes et al., 2025). Empirical evidence generally supports this linkage, but with notable limitations. For example, Saari et al. (2021) show that individuals displaying greater environmental knowledge are more likely to adopt behaviors like energy conservation and waste reduction, suggesting that knowledge facilitates behavioral translation. Drawing on the theory of planned behavior, Dermody et al. (2015) argue that knowledge influences attitudinal and control beliefs, two key determinants of behavioral intention. Informed individuals tend to hold favorable attitudes toward sustainability and perceive greater efficacy in enacting change, boosting their SCB (Sarkar et al., 2022). Beyond motivational factors, knowledge also serves as a heuristic device, guiding consumers through complex trade-offs among environmental, economic, and social considerations (Kherazi et al., 2024). This normative dimension highlights that knowledge does not merely inform choices but shapes underlying values and priorities, enabling consumers to move beyond superficial green behaviors toward systemic, impactful shifts.

However, these studies have tended to rely on self-report measures of knowledge and behavior, raising concerns about social desirability bias and the accuracy of claims made. Moreover, while consumers require environmental knowledge to engage in SCBs, knowledge alone may not suffice. For example, structural barriers (e.g., price/availability) may attenuate the effect of knowledge on actual behavior Lim et al. (2024), indicating that the strength of this association is contextually-dependent, and its direct impact remains empirically under-explored. Despite this insight, previous research tends to assume a linear knowledge-behavior effect without fully exploring its strength or boundary conditions. Addressing this issue, we examine whether pro-environmental knowledge significantly predicts SCB, reinforcing its role as a foundational cognitive resource for sustainability-oriented decision-making. We posit:

H3. Consumers' pro-environmental knowledge boosts their sustainable consumption behavior.

Consumer Religiosity and Sustainable Consumption Behavior. Consumer religiosity significantly influences decision-making, including consumption behavior. Religious teachings widely articulate ethical obligations that discourage excess, promote stewardship, and emphasize social responsibility Sumi et al. (2024), aligning closely with the

principles of SCB (Elhoushy and Jang, 2020). However, the influence of religiosity on consumption is not uniform: It operates through both individual moral intuition and communal reinforcement mechanisms, rendering its behavioral impact context-dependent (Aglozo and Cohen, 2025). SCB entails the adoption of value-driven, environmentally minded consumption (Dahrouj et al., 2025), rendering religiosity a powerful antecedent. For instance, Adil (2021) emphasizes that many religious traditions advocate for behaviors that reduce ecological harm and promote justice, resonating with the ethical core of SCB. These teachings often encourage compassion and accountability, which demonstrate in tangible practices like purchasing eco-friendly products, conserving energy, and supporting fair-trade goods (Tuhin et al., 2020). Yet, these findings are largely correlational and may reflect cultural norms (vs. intrinsic religiosity).

Minton et al. (2020) highlight the role of communal religious engagement, including participation in faith-based groups in reinforcing SCB. These collective settings foster shared ethical commitments and create normative pressure that encourages SCB. This finding aligns with Gullifor et al. (2023) who posit that group affiliation can shape individual attitudes and actions through normative and informational influence. Relatedly, Alsaad et al. (2020) suggest that framing sustainability as a spiritual obligation enhances perceived behavioral control and self-efficacy, bolstering the effect of religiosity on SCB. Taken together, the literature suggests a plausible connection but lacks clarity on whether religiosity exerts a direct influence on SCB or whether social conformity in religious communities and perceived control play a stronger role. We thus propose:

H4. Consumer religiosity boosts their sustainable consumption behavior.

Climate Change Anxiety and Sustainable Consumption Behavior. Climate change anxiety, a psychological response to concerns about the adverse impacts of climate change and its potential consequences, represents a significant driver of consumer behavior. Unlike general environmental concerns, this anxiety reflects a heightened affective state that often acts as a behavioral catalyst, prompting individuals to reassess their consumption choices in light of its perceived environmental threats (Lubowiecki-Vikuk et al., 2021). Theoretically, Kabasakal-Cetin (2023) suggest that emotional arousal enhances moral salience and strengthens behavioral intentions, particularly when the threat is perceived as immediate and personally relevant.

Empirically, Maduku (2024) shows that consumers exhibiting elevated climate anxiety are more likely to adopt eco-conscious practices like purchasing organic products and supporting environmentally responsible brands. Similarly, Shimul et al. (2024) report that climate-anxious individuals tend to reduce unnecessary purchases and prioritize resource conservation, indicating a shift toward SCB. However, these studies tend to rely on self-reported behavioral measures, which may inflate associations due to social desirability bias. Moreover, while anxiety appears to motivate SCB, its effect may not be uniform. Specifically, some studies suggest that excessive anxiety can lead to maladaptive coping strategies (e.g., avoidance/denial), rather than constructive behavior (Pickering and Dale, 2023). These findings raise questions about the threshold at which anxiety facilitates (vs. hinders) SCB. Accordingly, we propose:

H5. Climate change anxiety boosts their sustainable consumption behavior.

Moderating Role of Psychological Ownership. Psychological ownership, the feeling of possession over a target, even in the absence of formal ownership rights Morewedge et al. (2020), has gained traction in the sustainability context for its capacity to foster intrinsic motivation and deepen individuals' commitment to pro-environmental actions (Nwanzu and Babalola, 2024). Psychological ownership emerges through individuals' investment of their personal resources including time, effort, or emotional energy into an object or domain (e.g., the environment). This investment transforms the environment into a symbolic extension of the self, enhancing the perceived responsibility to protect and

preserve it. Mishra et al. (2022) note that psychological ownership aligns with identity-based motivation, which posits that individuals are likely to act in ways that affirm (vs. disconfirm) their self-concept. When the environment becomes part of one's psychological territory, SCB is no longer externally imposed but internally-driven (Winterich et al., 2023). This internalization process is critical in translating pro-environmental knowledge into meaningful consumption choices.

Though pro-environmental knowledge provides a cognitive foundation for SCB, its behavioral translation often depends on motivational factors. Psychological ownership serves as a catalyst in this process by reinforcing the knowledge/action interface (Shekari et al., 2024). When individuals perceive the environment as “theirs,” they are more likely to operationalize their knowledge into protective behaviors. This sense of stewardship strengthens behavioral intentions and promotes consistency in sustainable consumption (Wang et al., 2023). Psychological ownership also promotes a proactive orientation toward sustainability. Kang et al. (2023) demonstrate that individuals exhibiting high psychological ownership actively seek opportunities to engage in sustainable practices, moving beyond passive compliance (Kumar et al., 2025a). This proactive stance is echoed by Li and Atkinson (2020), who highlight that such individuals often become advocates for environmental causes, influencing others and amplifying the impact of their actions. This amplification effect highlights the moderating role of psychological ownership: It not only strengthens the knowledge-behavior link but also broadens its influence. Importantly, behaviors grounded in psychological ownership are inherently value-driven and enduring, distinguishing them from actions motivated by external pressures (Qiu et al., 2022). This intrinsic motivation ensures that sustainable actions are sustained over time. However, despite these extant insights, empirical evidence that explicitly examines the moderating role of psychological ownership in the effect of pro-environmental knowledge on SCB is yet to appear in the literature. We propose:

H6. Consumers' psychological ownership positively moderates the effect of their pro-environmental knowledge on their sustainable consumption behavior.

The research model is depicted in Fig. 4.

3.2. Methodology

3.2.1. Survey design

To ensure the reliability and validity of the adopted measures, these were adapted from widely used prior studies. While consumer religiosity and climate change anxiety were measured by adapting the scales of Elhoushy and Jang (2020) and Abunyewah et al. (2023), pro-environmental knowledge was measured by adapting the scale of Sampene et al. (2023). Finally, SCB and psychological ownership were measured by adapting the instruments of Lavuri et al. (2023), and Mishra and Malhotra (2021), respectively. All constructs were measured on five-point Likert scales [1 = strongly agree to 5 = strongly disagree]. To validate the survey, a pre-test with an expert researcher in SCB and consumer behavior was conducted, which indicated the suitability of the

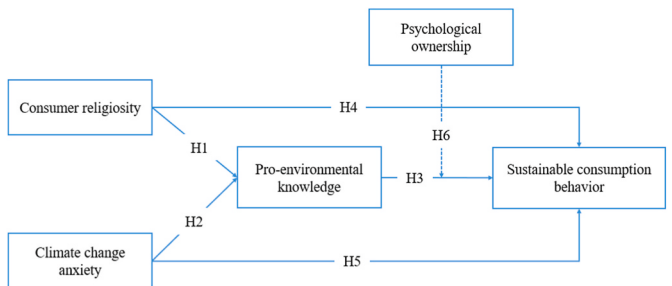


Fig. 4. Conceptual framework.

questionnaire in terms of its clarity, wording, and length.

3.2.2. Sampling and data collection procedures

Pre-data collection, we used the G*Power tool to determine the minimum required sample size for our model (Bartlett, 2019). Following established guidelines, we used the following input parameters: (effect size (f^2) = 0.15, significance level (α) = 0.05, power = 0.95, and predictors = 3), indicating a minimum sample size of 119.

Using purposive sampling, the data was collected from three different cities in the developing market of Pakistan. Surveys were distributed via a mall intercept approach (shopping malls/department stores). The following screening questions were used: “Do you have any knowledge about sustainable consumption?,” “Have you purchased any sustainable products in the last 1–2 months?,” and “Are you willing to support the increased production of sustainable products in the future through your own consumption?” Only respondents who answered “yes” to all questions were eligible to proceed to the main survey. After two months, a total of 308 responses was collected. Fourteen responses were removed due to incomplete information, yielding a final sample of 294 responses (see Table 2).

3.2.3. Common method bias assessment

As the data were collected from a single source (a self-report questionnaire), we assessed potential common method bias (CMB). Following Podsakoff et al. (2003), several procedural remedies were implemented at the design stage to minimize CMB. First, the questionnaire was structured clearly and logically, with distinct sections, appropriate headings, and introductory notes, helping to psychologically separate constructs and reduce the respondents' ability to infer hypothesized relationships, mitigating consistency-motivation bias. Second, to minimize social desirability bias and evaluation apprehension, respondents were assured of the confidentiality and anonymity of their responses and were informed that the data would be used solely for academic purposes (Fisher, 1993). Participants were also informed that there were no right/wrong answers and were encouraged to respond based on their knowledge.

Three post-hoc techniques were also employed to assess CMB. First, Harman's single-factor test revealed that the largest variance explained by a single factor was 33.37%, remaining well-below the 50% threshold

Table 2
Demographic statistics.

Description	Frequency	Percentage (%)
Gender		
Male	155	52.72
Female	139	47.28
Age (Years)		
Below 20	67	22.78
21–30	81	27.55
31–40	74	25.17
41–50	48	16.32
51–above	24	8.18
Highest Education Level		
Diploma	38	12.92
Under-graduate	135	45.91
Graduate	85	28.91
Postgraduate or above	36	12.26
Occupation		
Government Employee	107	36.39
Private Employee	86	29.25
Own Business	46	15.64
Housewife	41	13.94
Unemployed	14	4.78
Income Status (Pkr)		
Less than 50,000	22	7.48
50,001–100,000	109	37.09
100,001–150,000	86	29.25
150,001–200,000	46	15.64
More than 200,000	31	10.54

Fuller et al. (2016) and suggesting that CMB is unlikely to be of concern. Second, an unmeasured latent method construct (ULMC) was applied using SmartPLS. The results indicated that the method-factor loadings were weak and non-significant, and that its inclusion did not materially change the structural path coefficients (Podsakoff et al., 2003). Finally, a full collinearity assessment was performed, with the highest variance inflation factor (VIF) value being 2.65, remaining below the critical threshold of 3.3 (Hair et al., 2019). Collectively, these findings indicate that CMB was not an issue in our data.

3.3. Data analysis and results

3.3.1. Measurement model assessment

The measurement model was assessed using the reliability and validity of the factor loadings, composite reliability, Cronbach's alpha, convergent validity, and discriminant validity (Hair et al., 2020). Hair et al. (2019) suggest that the threshold of the outer loading should be at least 0.70, AVE ≥ 0.50 , reliability ≥ 0.70 , and HTMT ≤ 0.90 . The results indicated that all constructs met the respective reliability and validity criteria (see Table 3). Finally, discriminant validity was assessed using the Heterotrait-Monotrait (HTMT) ratio (< 0.90 ; (Henseler et al., 2015)). The HTMT values are shown in Table 4.

3.3.2. Structural model assessment

The structural model was assessed to test the hypotheses. To conduct the analysis, the model underwent testing using bootstrapping with 5000 samples (Alfons et al., 2021). The results reveal a significant positive effect of consumer religiosity ($\beta = 0.417$, $P = 0.000$) and climate change anxiety ($\beta = 0.310$, $P = 0.000$) on pro-environmental knowledge, supporting H1 and H2. The findings also reveal a significant positive effect of pro-environmental knowledge on SCB ($\beta = 0.417$, $P = 0.000$), supporting H3. Moreover, the results indicate a statistically positive impact of consumer religiosity ($\beta = 0.219$, $P = 0.007$) and climate change anxiety ($\beta = 0.225$, $P = 0.002$) on SCB, supporting H4 and H5.

The moderation results indicate that the interaction term (pro-environmental knowledge $\times$ psychological ownership) exerts a significant, positive effect on SCB ($\beta = 0.129$, $P = 0.009$), supporting H6. Further, the results suggest that the effect of pro-environmental knowledge on SCB rises under rising psychological ownership levels (see Fig. 5). The simple slopes findings display the effect of pro-environmental knowledge on SCB, which significantly differs at low (vs. high) psychological ownership. Overall, the hypothesis testing results are provided in Table 5.

3.3.3. Necessary condition analysis

Necessary condition analysis (NCA) was performed to explore what factors are necessary in shaping SCB. Based on Dul et al. (2018), an effect size (d) exceeding 0.1, and a p -value < 0.05 are considered necessary for outcome variables. We measured statistical significance by using the NCA permutation test with 10,000 resamples. The results in Table 6 reveal that consumer religiosity ($d = 0.106$, p -value < 0.002), climate change anxiety ($d = 0.143$, p -value < 0.001), and pro-environmental knowledge ($d = 0.121$, p -value < 0.001) are necessary conditions for the emergence of SCB, further supporting the PLS-SEM findings.

The bottleneck table (Table 7) further shows the minimum necessary condition levels that are required to reach specific outcome levels (e.g., 80% SCB), as follows: Consumer religiosity requires 1.02%, climate change anxiety 6.803%, and pro-environmental knowledge 1.701%, respectively. The scatter plots (Fig. 6) demonstrate the distribution and relationship of the data-points, while the comparative NCA/PLS-SEM results are shown in Table 8.

Table 3

Results - internal consistency reliability and convergent validity.

Constructs	Items	FL	CA	CR	AVE
Consumer religiosity	My faith influences all aspects of my consumption decision.	0.968	0.981	0.982	0.871
	In my life, I feel a sense of responsibility to make consumption choices based on my faith.	0.928			
	I am a religious person, and my faith affects my decisions regarding consumption in daily life.	0.928			
	Nothing is as important to me as making consumption choices that align with my faith and values.	0.930			
	My religious beliefs guide my approach to consumption and my decisions related to environmental responsibility.	0.943			
	I try hard to carry my religion over into all my consumption dealings in life.	0.918			
	One should seek God's guidance when making decisions related to consumption.	0.940			
	Religion is a central factor in shaping my decisions about sustainable consumption.	0.933			
	Religion plays an important role in guiding my moral decisions related to consumption.	0.909			
	My anxiety about climate change influences my purchasing decisions related to sustainable products.	0.918	0.973	0.973	0.820
Climate change anxiety	My anxiety about climate change affects my overall wellbeing and lifestyle choices.	0.889			
	My anxiety about climate change leads me to make consumption choices to address future uncertainties.	0.897			
	Climate change anxiety creates feelings of insecurity regarding my future consumption habits.	0.906			
	My anxiety about climate change leads to feelings of uncertainty about my future sustainable consumption choices.	0.894			
	My anxiety about climate change affects my engagement in social activities related to consumption.	0.909			

(continued on next page)

Table 3 (continued)

Constructs	Items	FL	CA	CR	AVE
Pro-environmental knowledge	My anxiety about climate change creates uncertainty regarding my long-term commitment to consumption practices.	0.919			
	My anxiety about climate change creates uncertainties about my ability to invest in sustainable practices.	0.911			
	My anxiety about climate change causes stress that influences my decisions regarding sustainable consumption.	0.907			
	I have a fair idea about environmental pollution caused by climate change.	0.958	0.972	0.972	0.898
	I have personally observed visible signs of environmental degradation.	0.930			
	I am aware of how to help mitigate environmental pollution.	0.944			
	I have enough knowledge of renewable and clean energy sources.	0.954			
	I know about air pollution, land pollution and ways to stop them.	0.952			
	I prefer to purchase organic and sustainably produced food products.	0.947	0.948	0.949	0.905
	I prefer to purchase eco-friendly items.	0.949			
Sustainable consumption behavior (SCB)	I prefer to purchase goods with less packaging and chemical use.	0.957			
	I feel like they are 'mine' when I use organic products.	0.893	0.938	0.978	0.795
	I feel a strong sense of personal ownership over the organic products I choose for consumption.	0.907			
	I feel like these organic products belong to me.	0.908			
	I feel a strong sense of closeness to the organic products I consume.	0.870			
Psychological ownership	Consuming organic products feels like an expression of who I am.	0.881			

Notes - *FL=Factor loading, CA=Cronbach's Alpha, CR=Composite reliability, AVE = Average variance extracted.

4. Discussion, implications, and limitations

4.1. Discussion

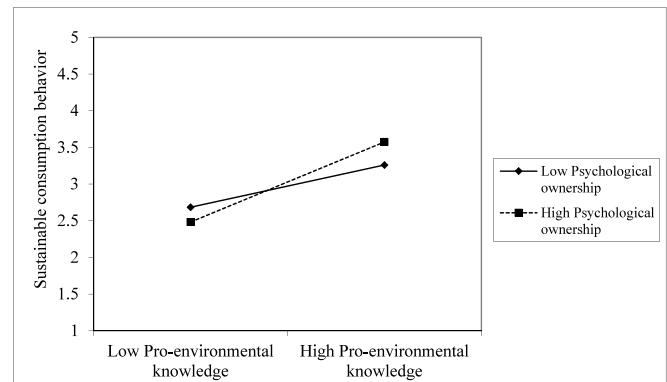
The finding for H1 indicates a positive, significant effect of CR on PEK, consistent with prior literature (Wang et al., 2020). In value-belief-norm theory, CR serves as a foundational value orientation that influences environmental beliefs and personal norms (Chung et al.,

Table 4

Discriminant validity (HTMT criterion).

	CCA	CR	PEK	PO	SCB
CCA					
CR	0.606				
PEK	0.571	0.615			
PO	0.074	0.156	0.086		
SCB	0.616	0.616	0.692	0.103	

Notes - *CCA=Climate change anxiety, CR=Consumer religiosity, PEK=Pro-environmental knowledge, PO = psychological ownership, SCB=Sustainable consumption behavior.

**Fig. 5.** Moderation results.**Table 5**

Hypothesis testing results (direct/moderation effects).

Hypotheses	Relationships	Beta (β)	St. Error	t-values	p-values	Decision
H1	CR -> PEK	0.417	0.082	5.062	0.000	Supported
H2	CCA -> PEK	0.310	0.080	3.886	0.000	Supported
H3	PEK -> SCB	0.417	0.074	5.670	0.000	Supported
H4	CR -> SCB	0.219	0.081	2.721	0.007	Supported
H5	CCA -> SCB	0.225	0.073	3.083	0.002	Supported
H6	PO x PEK -> SCB	0.129	0.050	2.595	0.009	Supported

* CR=Consumer religiosity, PEK=Pro-environmental knowledge, CCA=Climate change anxiety, SCB=Sustainable consumption behavior, PO = psychological ownership.

Table 6

NCA effect sizes.

Adoption of Sustainable consumption behavior		
Constructs	Original effect size	Permutation p value
Climate change Anxiety	0.143	0.00
Pro-environmental Knowledge	0.121	0.00
Consumer religiosity	0.106	0.002

2019). Religious teachings often emphasize ecological and moral responsibility, and care for creation, and these values are aligned with the biospheric and altruistic dimensions of the theory (Kala and Chaubey, 2023). These values foster a belief system supporting environmental protection, raising consumers' intrinsic motivation to acquire knowledge about environmental issues. As Minton et al. (2015) suggest, religious individuals are inclined to perceive environmental engagement as a moral duty, thereby encouraging deeper cognitive engagement with sustainability. The findings also align with those of (Arli et al., 2021), who note that religious consumers are widely motivated by economic considerations when making environmentally-conscious decisions. This

Table 7
Bottleneck table (%).

Sustainable consumption behavior	Climate change anxiety	Pro-environmental knowledge	Consumer religiosity
0.00%	0	0	0
10.00%	2.381	0	1.02
20.00%	2.381	1.701	1.02
30.00%	2.381	1.701	1.02
40.00%	2.381	1.701	1.02
50.00%	6.803	1.701	1.02
60.00%	6.803	1.701	1.02
70.00%	6.803	1.701	1.02
80.00%	6.803	1.701	1.02
90.00%	6.803	1.701	1.02
100.00%	12.585	1.701	1.361

Note: The gray shaded area shows the minimum percentage of each predictor variable necessary for high sustainable consumption behavior.

dual motivation that incorporates moral/economic factors reinforces the acquisition of pro-environmental knowledge, as consumers seek both ethical alignment and practical benefits in their consumption choices.

The result for H2 reveals that climate change anxiety significantly enhances pro-environmental knowledge, in line with (Gao et al., 2020). Drawing on value-belief-norm theory, climate change anxiety reflects consumers' increased awareness of the environmental consequences of their actions and a perceived personal responsibility to act, two key belief components that facilitate the interface of values and norms (Kühner et al., 2024). Climate change anxiety activates cognitive engagement, prompting consumers to seek information about environmental risks, causes, and solutions (Dahrouj et al., 2025). However, this effect may be contingent on certain boundary conditions, including

individuals' level of environmental involvement, cognitive capacity, or access to credible sustainability information, which can strengthen or weaken the translation of anxiety into knowledge acquisition.

This process is conducive to greater pro-environmental knowledge, as consumers become more informed and adapted to sustainability issues. Supporting this view, Hamzah and Tanwir (2021) report that those experiencing climate-related anxiety are disposed to process and retain environmental information. Additionally, Sharma and Palazzo (2024) emphasize that anxiety fosters a sense of urgency, pushing consumers to acquire the knowledge necessary for sustainable decision-making. However, this relationship may differ across socio-economic and cultural contexts, limiting its generalizability. Therefore, alternate explanations should be considered, as individuals possessing higher environmental knowledge may be more inclined to experience climate change anxiety, suggesting a potential reciprocal relationship. Moreover, factors including media exposure, education, and social norms may likewise influence both anxiety and knowledge. Underpinned by

Table 8
Results - PLS-SEM and NCA.

Independent variable	Dependent variable	PLS-SEM results	NCA results
Climate change anxiety	Sustainable consumption behavior	Significant	Significant as a necessary condition
Pro-environmental Knowledge	Sustainable consumption behavior	Significant	Significant as a necessary condition
Consumer religiosity	Sustainable consumption behavior	Significant	Significant as a necessary condition

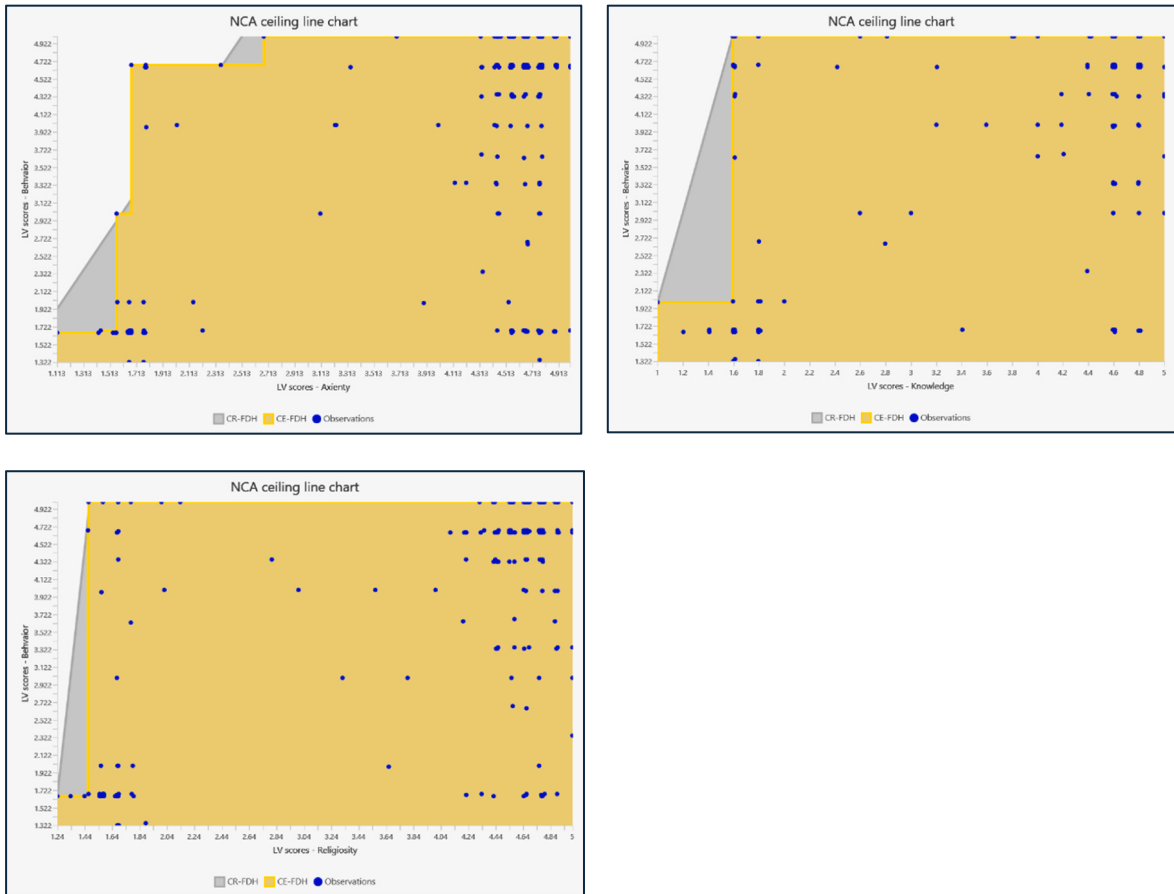


Fig. 6. Scatter-plots - Predictor Variables vs. SCB.

value-belief-norm theory, this emotional response strengthens the belief-norm pathway, reinforcing the link between environmental concern and informed behavior.

The finding for H3 confirms that pro-environmental knowledge significantly influences SCB, aligning with (Dermody et al., 2015). According to the value-belief-norm theory, knowledge about environmental issues contributes to the formation of ecological beliefs and the activation of personal norms (Raghu and Rodrigues, 2021). As consumers become more informed about the consequences of their consumption choices, they are more likely to adopt environmentally conscious behavior. This knowledge serves as a cognitive foundation for sustainability-oriented decision-making, guiding them toward practices that minimize ecological impact. Johnstone and Lindh (2022) further support this effect, noting that informed consumers tend to actively engage in sustainable consumption.

The insight gleaned for H4 indicates that consumer religiosity significantly enhances SCB, consistent with (Abunyewah et al., 2023). Religiosity, as a value orientation in value-belief-norm theory, shapes environmental beliefs and activates personal norms rooted in moral and spiritual principles. Religious teachings often promote environmental and social responsibility, and ethical living, which align with SCB. Zeqiri et al. (2022) emphasize that religious identity reinforces moral norms, which guide behavior in accordance with faith-based principles. Kaplan and Iyer (2021) further suggest that religious consumers view sustainability as a moral obligation, integrating environmental concern into their daily practices. Therefore, religiosity strengthens the belief-norm pathway, encouraging consumers to align their consumption choices with their spiritual and ethical values.

The findings for H5 confirmed the existence of a significant effect of climate change anxiety on SCB, consistent with (Rahimah et al., 2018). These authors highlight that those experiencing climate change anxiety tend to exhibit greater SCB. In value-belief-norm theory, climate change anxiety reflects consumers' increased awareness of environmental threats and a strong sense of personal responsibility, each of which contributes to the activation of their personal norms. More climate-anxious consumers tend to be determined to mitigate environmental risk through their behavior (e.g., by engaging in SCB). However, this effect may be contingent on boundary conditions like income, the availability of sustainable alternatives, and perceived behavioral control, which can either facilitate or constrain the translation of anxiety into actual sustainable consumption behavior.

This emotional response enhances the prominence of environmental values and reinforces their normative commitments to sustainability. This finding is also supported by Cao et al. (2021), who suggest that climate change anxiety can cause cognitive dissonance, where consumers feel discomfort due to conflicting beliefs or behaviors. This dissonance, caused by a contradiction between caring about the environment and engaging in less sustainable consumption, motivates consumers to align their actions with their environmental values, raising SCB. Alternate explanations may also account for this relationship, because factors including social norms, environmental awareness, or prior pro-environmental attitudes may simultaneously influence climate change anxiety and SCB, suggesting a potentially reciprocal or spurious association. Furthermore, the relationship between climate change anxiety and SCB may not be strictly linear; while moderate anxiety can motivate constructive behavioral change, at high levels it may yield emotional exhaustion, denial, or disengagement, reducing the probability of sustainable consumption and suggesting a possible inverted U-shaped effect.

H6 reveals that psychological ownership positively moderates the relationship between pro-environmental knowledge and SCB. This finding highlights the role of psychological ownership as a value-belief-norm catalyst, enhancing the translation of knowledge into action and contributing to reducing the intention-behavior gap. Psychological ownership reflects a personal connection to environmental outcomes, strengthening individuals' normative commitment to sustainability. As

Xu et al. (2022) note, while pro-environmental knowledge raises awareness, psychological ownership enhances intrinsic motivation to act on that knowledge and make sustainable choices (Degbey et al., 2021). Relatedly, Yoshida et al. (2021) emphasize that individuals exhibiting higher psychological ownership of environmental issues are more likely to engage in behaviors that reflect their values and beliefs. Therefore, those who feel they have a personal stake in the outcomes of their behaviors tend to be more committed to adopting SCBs. This emotional connection to environmental outcomes fosters a sense of responsibility and ownership over the environmental impact of one's choices. In value-belief-norm theory, psychological ownership reinforces the belief-norm pathway by fostering a sense of responsibility and self-efficacy (Kumar, 2021; Peck et al., 2020). Further support this view, stating that psychological ownership empowers consumers to make meaningful contributions to sustainability. By enhancing the emotional and cognitive connection to environmental outcomes, psychological ownership strengthens the impact of pro-environmental knowledge on SCB.

Finally, the necessary condition analysis illuminates those factors that are critical in shaping SCB. The results indicate that the presence of climate change anxiety, pro-environmental knowledge, and consumer religiosity, is crucial to foster SCB. The findings further reveal that climate change anxiety and pro-environmental knowledge are particularly important in promoting SCB, as they support the notion that individuals who feel anxious about the consequences of climate change and who have greater pro-environmental knowledge are more aware of environmental risks and responsibilities. This heightened awareness, in turn, motivates them to adopt SCBs. Our NCA-based contribution builds on prior research by incorporating a constraint-based perspective on sustainability and SCB. Specifically, our findings demonstrate that not all drivers contribute equally to SCB. Therefore, it is necessary to differentiate between factors that initially attract consumers and those that create long-term engagement.

4.2. Theoretical implications

This research offers important theoretical implications. First, it advances the sustainability literature by examining religiosity, pro-environmental knowledge, and climate change anxiety as key psychological mechanisms at the consumer level. While prior literature, particularly that which is framed around VBN theory, emphasizes values, beliefs, and personal norms as primary drivers of sustainable consumption, these factors are often implicitly treated as both sufficient and stable across contexts. However, this research extends VBN theory by incorporating PEK and demonstrating that it functions as a necessary condition, highlighting that values and norms alone may be insufficient to drive SCB in developing country contexts with limited awareness and understanding (Khan et al., 2025). We also refine VBN theory by incorporating threshold conditions, emotional drivers, and cultural context, offering a more nuanced and context-sensitive understanding of SCB.

Second, the moderating role of psychological ownership deepens understanding of how pro-environmental knowledge translates into sustainable consumption in VBN theory. The theory argues that beliefs activate personal norms only when individuals feel morally connected to environmental outcomes (Park et al., 2022). Our findings show that this connection becomes stronger when people experience psychological ownership and view environmental protection as partly being their own responsibility. Here, knowledge about environmental issues does not remain a passive belief but becomes personally relevant and is more easily transformed into sustainable action. However, when psychological ownership is low, even extensive environmental knowledge does not effectively activate personal norms. This pattern illustrates that the theory's belief-to-norm pathway is not automatic but depends on consumers' sense of accountability. By identifying psychological ownership as a condition that enhances the translation of beliefs into norms and

behavior, our study clarifies why individuals possessing similar environmental knowledge may differ in their SCB, strengthening VBN theory by highlighting a key identity-linked mechanism that shapes pro-environmental action (Lyu et al., 2023; Zhang et al., 2026).

Finally, this research advances sustainable consumer behavior literature by demonstrating how a combination of bibliometric analysis, PLS-SEM, and NCA can be employed as an extended analytical approach, providing deeper insight for research and practice. The bibliometric analysis offers a structured understanding of the intellectual landscape of the field, while the PLS-SEM results highlight net effects, establishing the examined constructs as sufficient conditions. While the NCA findings reveal the existence of minimum thresholds required to achieve sustainable consumption behavior (Rasoolimanesh, 2026), the bottleneck analysis (Table 7) illustrates that climate change anxiety acts as a progressively binding constraint in the development of SCB, whereas PEK and CR function as baseline enablers (vs. escalating constraints). This distinction advances theoretical understanding by showing that SCB is not driven solely by additive effects, but also by constraint-based mechanisms. Furthermore, the findings indicate an asymmetric causal structure: CCA plays a dominant constraining role at higher behavioral levels, while PEK and CR provide foundational support across all levels (Liao et al., 2026).

4.3. Managerial implications

The three-stage hybrid analysis enables the derivation of actionable insights for practitioners and policymakers to promote SCB. Overall, the PLS-SEM results highlight the importance of CCA, PEK, and CR as key drivers of SCB, while the NCA findings add insight into the prerequisites of SCB.

First, the results identify CCA as a key driver, particularly at higher SCB levels, as it acts as a progressively binding constraint in the bottleneck analysis. This suggests that managers and public agencies should treat climate-related risks and emotional engagement as actionable levers (vs. abstract psychological states; Urbonavicius et al., 2025). Through bottleneck analysis, sustainability campaigns can be made more effective by combining emotionally engaging narratives with clear, credible educational content (Hollebeek and Macky, 2019). For example, retailers and public agencies may collaborate to develop video-campaigns or in-store digital displays illustrating the local consequences of climate change, while demonstrating foundational everyday consumer actions to mitigate this risk (e.g., choosing organic products/reducing plastic use). Brands may also use social media, mobile apps, or point-of-sale materials to present eco-label explanations (Hollebeek and Macky, 2019), carbon footprint comparisons, or sustainability tips that empower consumers to act on their environmental concerns and make more responsible consumption choices that advance both societal well-being and environmental preservation (Kumar et al., 2025).

Second, the NCA findings indicate that PEK and consumer religiosity CR emerge as baseline enablers that must be present to drive SCB at a meaningful level. This implies that policymakers and marketers should promote SCB through a combination of emotionally engaging narratives and context-specific, culturally grounded approaches (*religious values and norms*) to encourage consumers to adopt and sustain such behaviors. This is especially relevant in Pakistan and many other countries where consumers are strongly motivated by religious values. For instance, authors including Goswami et al. (2025) and Nguyen et al. (2025) suggest that incorporating emotional/cognitive elements alongside religiosity-related themes, symbols, and/or related cues in green advertising can be highly effective in national cultures featuring a long-term orientation.

From a broader SCB perspective, our results offer actionable insights for public and private institutions seeking to design social movements aimed at environmental protection and achieving the U.N.s' 12th Sustainable Development Goal (SDG 12): Responsible Consumption and

Production. The findings highlight that such initiatives should not focus solely on rational or informational appeals. Instead, they should integrate emotional (anxiety-driven), cognitive (knowledge-based), and value-based (religiosity or ethical orientation) strategies to effectively influence behavior. Moreover, the NCA insights can help businesses and policymakers identify when key SCB drivers fall below critical thresholds, enabling timely corrective action to sustain engagement.

4.4. Limitations and future research

This study also has limitations that offer additional research avenues. First, the study is conducted in a single developing market context (Pakistan), limiting the generalizability of the findings (Hollebeek, 2018). Though SCBs exhibit a level of cross-cultural transferability, replication and extension of the proposed research design across other (e.g., cultural) settings is therefore recommended. Second, the cross-sectional research design limits the development of insight into the evolution of the modeled constructs over time. We thus advise future studies to conduct longitudinal exploration of the modeled dynamics to further advance understanding in this area (So et al., 2024).

Third, the sample size remains relatively small, potentially further limiting the generalizability of the findings. Therefore, future research may wish to replicate and extend the model with (a) larger sample size (s). Finally, while we assessed the moderating role of psychological ownership, other moderators may be used, which can uncover additional insight (e.g., consumers' internal/external locus of control, or locomotion/assessment-based regulatory mode (Septianto et al., 2023)).

CRedit authorship contribution statement

Bilal Mukhtar: Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Conceptualization. **Ali Hussain:** Validation, Methodology, Investigation, Formal analysis. **Linda D. Hollebeek:** Writing – review & editing, Visualization, Methodology, Investigation, Conceptualization. **Denni Arli:** Writing – review & editing, Visualization, Supervision, Conceptualization.

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.

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