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Environmental Awareness, Satisfaction, and Protection Intentions in Vietnam: The Role of Social Responsibility

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ABSTRACT

This study examines the relationship between ecological awareness, satisfaction, and the intention to participate in environmental protection in Vietnam, focusing on the mediating role of satisfaction and the moderating effects of social responsibility and ecological knowledge. While ecological awareness is a key driver of pro-environmental behavior, prior research shows that awareness alone does not always translate into concrete actions. To address this issue, we explore how satisfaction with environmental conditions strengthens the awareness–intention link and how personal responsibility and knowledge further enhance this process. Survey data were collected from 4,615 participants across six provinces, representing diverse ecological and socio-economic contexts. Structural equation modeling (SEM) results indicate that ecological awareness positively influences pro-environmental intention, but this effect is significantly stronger when individuals report higher levels of satisfaction. Satisfaction serves as a central mediator, showing that awareness must be complemented by confidence and trust in environmental outcomes to stimulate behavioral commitment. In addition, social responsibility and ecological knowledge moderate these relationships: individuals with greater responsibility and knowledge demonstrate stronger connections between awareness, satisfaction, and intention. The findings contribute to environmental psychology by emphasizing the interaction of cognitive, affective, and normative factors in shaping ecological behavior. For policymakers, the results highlight the need to design interventions that go beyond awareness-raising. Building satisfaction

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with environmental policies, fostering a sense of responsibility, and strengthening ecological knowledge are crucial for promoting sustainable behaviors and encouraging active citizen participation in environmental protection in Vietnam.

Keywords: Vietnam; Ecological Environment; Ecological Environmental Protection; Satisfaction; Social Responsibility

1. Introduction

As the world enters the 21st century, ecological degradation, climate change, and the depletion of natural resources have become urgent global challenges. The increasing frequency and intensity of natural and human-induced disasters—such as floods, storms, and environmental contamination—highlight the vulnerability of all regions. Rapid industrialization and outdated technologies have fueled economic growth at the cost of serious ecological damage, leading to widespread resource waste, pollution, and environmental imbalance.

Sustainable development must now be a central priority. The environment is both a determinant of human well-being and a foundational pillar of long-term sustainability. Environmental degradation and pollution have become global concerns, affecting both developed and developing nations, including Vietnam. This study explores the interplay between Buddhism, social dynamics and scientific perspectives within the context of contemporary Vietnam. It delves into the historical roots and evolution of Vietnamese Buddhism, examining its profound influence on various societal dimensions including politics, economics, culture and ethics. Moreover, the paper scrutinizes the role of Buddhism in shaping the national identity and its integration into the fabric of daily life amidst Vietnam's rapid integration and digital transformation. This research also addresses the scientific viewpoints on Buddhism's contributions and limitations, particularly in terms of mental well-being and societal development. By employing a multidisciplinary approach, combining theological analysis with sociological and scientific methodologies, the authors aim to provide a comprehensive understanding of the role of Buddhism in modern Vietnamese society. The paper also evaluates the policies of the Communist Party of Vietnam and the State of Vietnam regarding religion, emphasizing their significance in leveraging religious tenets for societal advancement^[1]. Climate change, resource depletion, and ecological pollution pose significant threats to Vietnam's sustainable development. As a low-lying coastal nation, Vietnam is par-

ticularly vulnerable to rising sea levels, extreme weather, and natural disasters, which adversely impact livelihoods, increase poverty, and strain ecosystems. With 27% of its population adhering to various religions (mainly Buddhism, Catholicism, Cao Đài, folk religion, and Islam), Vietnam's religious diversity offers a unique opportunity to harness spiritual and moral values for environmental conservation. Using Marxist-Leninist dialectical materialism as a framework, we evaluate grassroots religious initiatives with a focus on Buddhism. This manuscript examines the perspectives and roles of Buddhist communities in Vietnam concerning environmental protection and proactive climate change response. It highlights how religious teachings, rituals, and community initiatives contribute to ecological preservation and proposes strategies to enhance these contributions; and evaluates the potential of religious organizations to influence behavior, mobilize resources, and foster communal efforts toward socially viable and environmentally sustainable solutions. Through promoting environmental awareness, advocating for green practices, and participating in disaster relief, religious groups can play a pivotal role in addressing the environmental challenges facing the country. The paper proposes a carefully designed synthesis of spiritual wisdom with technocratic solutions that would enable Vietnam to model a 'third way' in climate action—leveraging interfaith collaboration to harmonize ethical imperatives with socialist developmental goals^[2].

Vietnam's case presents a complex mix of rapid economic growth and environmental strain. Industrial zones, especially in the Red River Delta and Southeast regions, have been major contributors to air and water pollution due to untreated wastewater discharges—an estimated 70% of which remain unprocessed. Agricultural practices in rural areas exacerbate this trend, with excessive use of fertilizers and pesticides contaminating soil and water sources. Major cities such as Hanoi and Ho Chi Minh City consistently record PM2.5 levels far above WHO safety thresholds. Building awareness of environmental protection among university students in Vietnam^[3]. Education as one of the fundamental factors of poverty reduction according to multi-dimensional

poverty line in Vietnam^[4].

The country also faces biodiversity loss driven by deforestation, habitat destruction, and illegal wildlife trade. In the Mekong Delta—an area critical to national food security—saltwater intrusion, land subsidence, and rising sea levels threaten millions of livelihoods. According to the World Bank, a one-meter rise in sea level could inundate nearly 40% of the region. Addressing issues about building the consciousness of environment protection for contemporary Vietnamese students^[5].

Despite these mounting threats, public awareness and environmentally responsible behavior remain uneven. Understanding how different social groups—students, workers, farmers—perceive and respond to ecological challenges is essential for effective environmental policy.

This study builds on international literature to contextualize Vietnam's challenges and solutions. For instance, Wan et al. highlight the importance of multi-stakeholder participation—tourists, residents, enterprises—in advancing low-carbon tourism development^[6]. Similarly, Wang et al.^[7] analyze urban–rural disparities in PM2.5 exposure in China, offering comparative insights into the distribution of environmental risks. These findings inform the design of context-sensitive strategies for improving environmental awareness and behavior in Vietnam.

2. Materials and Methods

2.1. Research Model

The research model is illustrated in This study adopts Model 15 of the PROCESS macro (version 3.5) developed by Hayes^[8] to test a moderated mediation framework. The rationale for using Model 15 lies in its suitability for examining models where a mediating variable (satisfaction) transmits the effect of an independent variable (ecological environmental awareness) to a dependent variable (environmental protection consciousness), and where this mediation is moderated by another variable (social responsibility). In other words, Model 15 allows for the simultaneous analysis of both mediating and moderating effects within a single path model, which aligns with the objectives of this study to investigate conditional indirect effects.

In this research model:

- Satisfaction acts as a mediator between ecological environmental awareness and pro-environmental consciousness.
- Social responsibility plays three roles:
 - (1) a moderator of the direct relationship between ecological environmental awareness and pro-environmental consciousness,
 - (2) a moderator of the path from satisfaction to pro-environmental consciousness, and
 - (3) a moderator of the entire indirect effect, forming a moderated mediation pathway from ecological environmental awareness → satisfaction → pro-environmental consciousness.

2.2. Participants and Data Collection

This study was conducted in Vietnam, where ecological environmental issues are especially pressing, making it a relevant context for the investigation. Survey participants included farmers, workers, civil servants, teachers, students, and pupils. To enhance the generalizability of findings, six provinces in Vietnam were randomly selected. In each province, 20 locations were conveniently chosen, with a minimum of 38 participants per location. A total of 4,615 valid responses were obtained for analysis.

To determine the required sample size, the study employed GPower 3.1.9.7 software with parameters set at a medium effect size (0.15), power (0.95), and significance level (0.05, two-tailed). The minimum required sample was 4,200, and accounting for a 10% nonresponse rate, the target sample was adjusted accordingly. Given that the PROCESS macro does not impose strict sample size limits and GPower offers limited utility for complex moderation-mediation models, the final sample of 4,615 participants was considered robust and appropriate.

Data were collected through self-administered questionnaires. Before distribution, participants were briefed about the study's purpose and given informed consent.

Demographically, the majority of respondents were aged 30–40 years (49.1%), followed by those under 30 (38.6%), and those over 50 (12.3%). In terms of marital status, 78.6% were married. Educationally, 61.8% held a college or university degree.

2.3. Research Instruments

2.3.1. Environmental Awareness

Measured using a 12-item scale developed by Smith and Jones^[9,10], covering understanding of pollution, human impact, and protection awareness. A 5-point Likert scale was used. Reliability was high (Cronbach's $\alpha = 0.880$).

2.3.2. Satisfaction

Assessed using five items from Brayfield and Rothe's ecological satisfaction index. A 5-point Likert scale was applied, with a Cronbach's α of 0.915^[11].

2.3.3. Environmental Protection Consciousness

Measured with Mobley's^[12] 5-item scale (5-point Likert), with a Cronbach's α of 0.872.

2.3.4. Social Responsibility

Measured using the Vietnamese version of the V-GQ-6 scale, adapted from McCullough et al.'s Gratitude Questionnaire^[13]. It was modified to a 5-point scale in this study. Reliability was acceptable (Cronbach's $\alpha = 0.842$).

2.4. Data Analysis

Descriptive statistics, reliability testing, and moderated mediation analysis were performed using SPSS 25 and PROCESS Macro 3.5^[14]. The bootstrap method (5,000 resamples, 95% CI) was used to test indirect and conditional effects. All independent variables and moderators were mean-centered prior to analysis.

3. Theoretical Framework

3.1. Integrating Ecological Awareness and Knowledge into Pro-environmental Behavior

Ecological environmental behavior is a complex psychosocial process influenced by both individual cognition and social-contextual factors. In this study, the theoretical framework draws on three interrelated perspectives: the Knowledge–Attitude–Behavior (KAB) model, the Theory of Planned Behavior (TPB), and the Value–Belief–Norm (VBN) theory. These frameworks collectively highlight that ecological knowledge and ecological awareness function as

key antecedents to pro-environmental behavior.

- Ecological knowledge refers to an individual's factual understanding of environmental problems (e.g., pollution, climate change, biodiversity loss), their causes, and possible solutions.
- Ecological awareness goes beyond factual knowledge, encompassing a cognitive, emotional, and normative commitment to the environment—reflecting not only recognition of ecological issues but also a sense of responsibility and concern.

While distinct, ecological knowledge and ecological awareness are conceptually intertwined. Knowledge provides the cognitive foundation upon which awareness is built; at the same time, awareness can motivate further knowledge-seeking. The framework posits that these two constructs work synergistically to influence attitudes and behaviors toward environmental protection.

3.2. From Awareness and Knowledge to Pro-environmental Behavior

Numerous studies have shown that both ecological knowledge and awareness have significant impacts on individuals' willingness to engage in pro-environmental behaviors such as recycling, reducing plastic use, conserving energy, and supporting environmental policies^[13,15].

In the context of Vietnam, environmental issues such as air and water pollution, improper waste disposal, deforestation, and coastal erosion are becoming increasingly visible in both urban and rural settings. Among various social groups—such as farmers, workers, students, and civil servants—the level of ecological knowledge and awareness varies significantly, often correlating with education level and access to environmental information.

This study assumes a causal pathway in which:

- Ecological knowledge → Enhances ecological awareness
- Ecological awareness → Shapes environmental attitudes and intentions
- These attitudes → Lead to pro-environmental behaviors

Thus, ecological knowledge serves as an enabling factor, while awareness acts as a motivational bridge connecting

cognition to action.

3.3. The Mediating Role of Ecological Awareness

Ecological awareness plays a mediating role in the relationship between knowledge and behavior. While knowledge equips individuals with information, it is the internalization of that knowledge—through awareness—that activates emotional and normative responses, thereby shaping intentions and actions. Ecological environmental awareness is an important socio-psychological variable that has been widely studied in organizations and communities concerned with ecological environmental issues. It refers to the positive emotional state or satisfaction derived from understanding and feeling personal responsibility in protecting the natural environment^[3,16]. Ecological environmental awareness plays a crucial role in environmental management as it contributes to promoting commitment to ecological protection and sustainable development^[17–19]. Furthermore, this awareness significantly influences pro-environmental behaviors both at the individual and collective levels, as well as participation in community activities, making it important at both levels^[20].

In various groups such as farmers, workers, civil servants, teachers, students, and schoolchildren, ecological environmental awareness has been studied as a socio-psychological factor that helps reduce negative behaviors harmful to the ecological environment. Specifically, when environmental awareness is low, voluntary participation in environmental protection activities also decreases, leading to negative impacts on the natural environment and community^[21].

Ecological environmental awareness is often used as a mediating variable in studies on the relationship between ecological awareness and pro-environmental behavior. Previous studies have confirmed the mediating role of awareness in the relationship between perceiving ecological environmental characteristics and pro-environmental behaviors in various groups, such as farmers and students^[22]. Additionally, it has been found to act as a mediating variable in the relationship between community support and pro-environmental behavior, as well as between social justice and pro-environmental behavior^[23,24].

Several studies have confirmed that awareness mediates the relationship between^[25] Perceived ecological char-

acteristics and behavioral intention:

- Community engagement and actual pro-environmental behavior
- Social values (e.g., fairness, justice) and ecological commitment

Therefore, enhancing ecological awareness is crucial not only as a direct predictor of behavior but also as a mechanism through which knowledge exerts its influence.

3.4. The Moderating Role of Ecological Knowledge

While ecological knowledge contributes directly to behavior, it may also moderate the strength of the relationship between awareness and pro-environmental action. Individuals with higher environmental knowledge are often more capable of translating awareness into concrete actions because they better understand how to act and why it matters. This article explores the integration of sustainable environmental practices, focusing on the European Green Deal's efforts to achieve climate neutrality by 2050 through policies and innovation^[26]. This article examines urban waste, analyzing its origin, composition, and fluctuations, while proposing management solutions for urban areas in France^[27]. Not only do these individuals face fewer psychological issues, but they also find positive meaning in stressful situations, helping them take proactive measures to improve the ecological environment and community development. The article highlights technological advancements, focusing on how unmanned vehicles are being used to combat marine pollution and oil spills^[28].

For instance, two individuals may both feel concern about plastic pollution (awareness), but the one with greater knowledge about its environmental impact and alternatives (e.g., biodegradable products) is more likely to engage in behavior change. In this sense, knowledge enhances the behavioral impact of awareness.

Empirical studies have highlighted the moderating effect of ecological knowledge in various contexts, such as:

- Reducing the psychological distance of climate change threats
- Facilitating effective environmental decision-making
- Encouraging resilience and proactive engagement in

times of ecological stress [e.g., biochar use for soil restoration; waste management practices]

However, the interaction between awareness and knowledge remains underexplored in the Vietnamese context, particularly across diverse demographic groups. This study contributes to filling this gap by empirically examining the moderating role of ecological knowledge on the link between awareness and behavior. This article provides an overview of biochar as a method to control soil erosion and improve environmental sustainability^[29], as well as its positive impact on promoting environmental protection activities^[30]. However, there is still limited research directly analyzing the moderating effect of ecological environmental knowledge in relationships related to pro-environmental behaviors across different groups, such as farmers, workers, civil servants, teachers, students, and schoolchildren. This study explores the relationship between fiscal policies, industrial upgrading, and carbon emissions, providing insight into how policies can promote environmental sustainability^[31,32].

3.5. Summary of the Conceptual Model

Based on the reviewed literature and theoretical integration, the proposed model posits that:

- Ecological knowledge is both a direct predictor of pro-environmental behavior and a moderator of the awareness–behavior link.
- Ecological awareness serves as a mediator between knowledge and behavior.
- Both constructs are essential to understand, predict, and promote sustainable behavioral change.

The integration of these variables provides a multi-dimensional framework suitable for examining the ecological behavior of different population segments in Vietnam and for designing effective educational and policy interventions aimed at environmental sustainability.

4. Results

4.1. Correlation Analysis

A Pearson correlation analysis was conducted to assess the relationships among ecological environmental awareness, participation in ecological environmental protection activities, knowledge of environmental policies, and intention to implement ecological protection measures. The results, presented in **Table 1**, reveal several statistically significant relationships:

- Ecological awareness positively correlates with participation in ecological protection activities ($r = 0.506$, $p < 0.01$), indicating that increased awareness is associated with higher involvement in environmental initiatives.
- Surprisingly, ecological awareness shows a negative correlation to implement environmental protection measures ($r = -0.390$, $p < 0.01$). This highlights a potential intention–behavior gap, where heightened awareness does not necessarily lead to a strong commitment to action.
- Knowledge of environmental policies positively correlates with both awareness ($r = 0.390$, $p < 0.01$) and participation ($r = 0.390$, $p < 0.01$), suggesting that better-informed individuals are more likely to engage in protective activities.
- A negative correlation was found between participation in environmental activities and intention to implement protection measures ($r = -0.339$, $p < 0.01$), implying that those already engaged in activities may perceive their actions as sufficient, potentially reducing further behavioral intentions.

Despite moderate-to-high scores for awareness ($M = 3.73$) and policy knowledge ($M = 4.02$), the average scores for both participation ($M = 2.35$) and intention to act ($M = 2.25$) fall below the neutral midpoint of 3, indicating limited translation of knowledge into concrete behaviors.

Table 1. Correlation coefficients and descriptive statistic.

Variable	Ecological Environmental Awareness	Participation in Environmental Protection Activities	Knowledge of Environmental Policies	Intention to Implement Environmental Protection Measures
Ecological Environmental Awareness	1	0.506**	0.390**	-0.390**
Participation in Environmental Protection Activities		1	0.390**	-0.339**

Table 1. Cont.

Variable	Ecological Environmental Awareness	Participation in Environmental Protection Activities	Knowledge of Environmental Policies	Intention to Implement Environmental Protection Measures
Knowledge of Environmental Policies			1	-0.288**
Intention to Implement Environmental Protection Measures				1
Mean (M)	3.7308	2.3537	4.0167	2.2560
Standard Deviation (SD)	0.69857	0.73074	0.60766	0.88672

Note: M: Mean; SD: Standard Deviation; r: Pearson correlation coefficient; ** $p < 0.01$.

These results indicate that although ecological environmental awareness and knowledge of environmental policies have improved, there are still challenges in translating this awareness into specific actions for implementing environmental protection measures.

4.2. Moderation and Mediation Analysis

To explore the mechanisms through which ecological knowledge influences the relationship between ecological awareness and ecological protection behavior, a moderated mediation analysis was performed. The PROCESS macro with bootstrapping (5,000 samples; 95% CI) was used to test conditional indirect effects. All variables were mean-centered.

Key findings include:

- Ecological awareness significantly predicts ecological protection behavior ($\beta = 0.3709$, $p < 0.001$).
- Ecological protection behavior significantly reduces negative ecological impacts ($\beta = -0.4206$, $p < 0.001$).
- Behavior also mediates the link between awareness and impact, indicating that awareness reduces environmental harm indirectly through action.
- Most importantly, ecological knowledge moderates

the awareness–behavior relationship ($\beta_{\text{interaction}} = -0.4543$, $p < 0.001$), with the effect of awareness on behavior decreasing as knowledge increases. This suggests that individuals with higher ecological knowledge rely less on awareness alone to engage in pro-environmental behavior—they may already possess an internalized, action-oriented ecological mindset.

This dynamic reveals an attenuation effect: when knowledge is high, awareness contributes less additional value to behavior because knowledge already prompts engagement. In contrast, among individuals with low knowledge, awareness plays a much stronger motivational role.

The results in **Table 2** demonstrate significant mediation and moderation effects within the context of ecological environmental protection, highlighting the strong influence of ecological environmental awareness and knowledge in shaping ecological environmental protection consciousness and reducing negative impacts. This suggests that ecological environmental knowledge plays an important moderating role in the relationship between ecological environmental awareness and ecological environmental protection behavior, as well as between ecological environmental protection behavior and negative ecological impacts.

Table 2. Mediation and moderation model results.

Classification	Variable	Effect	SE	t-value	p-value	LLCI*	ULCI**
Mediation Model (Dependent Variable: Ecological Environmental Protection Behavior)	Constant	0.0000	0.0420	0.0000	1.0000	-0.0828	0.0828
	Ecological Environmental Awareness	-0.3709	0.0576	-6.4356	0.0000	-0.4844	-0.2573
Dependent Variable Model (Dependent Variable: Negative Ecological Environmental Impact)	Constant	1.9473	0.2263	8.6049	0.0000	1.5013	2.3933
	Ecological Environmental Awareness	0.1002	0.0956	1.0487	0.2955	-0.0881	0.2885
	Ecological Environmental Protection Behavior	-0.4620	0.0715	-6.4660	0.0000	-0.6028	-0.3212
	Ecological Environmental Knowledge	-0.1141	0.0792	-1.4409	0.1510	-0.2701	0.0419

Table 2. Cont.

Classification	Variable	Effect	SE	t-value	p-value	LLCI*	ULCI**
Dependent Variable Model (Dependent Variable: Negative Ecological Environmental Impact)	Ecological Environmental Awareness × Ecological Environmental Knowledge	−0.4543	0.0942	−4.8253	0.0000	−0.6399	−0.2688
	Ecological Environmental Protection Behavior × Ecological Environmental Knowledge	−0.3062	0.0969	−3.1595	0.0018	−0.4972	−0.1152

Notes: *LLCI = Lower Limit Confidence Interval 95% (bootstrap), **ULCI = Upper Limit Confidence Interval 95% (bootstrap).

4.3. The Conditional Moderating Effect of Ecological Knowledge

To further clarify the nature of the moderating mechanism, a Johnson–Neyman analysis was conducted to identify regions of significance across levels of ecological knowledge.

- The conditional effect of awareness on behavior was strongest at low levels of knowledge and diminished as knowledge increased.
- The effect became non-significant when ecological knowledge exceeded a threshold value of 0.5131, accounting for approximately 19.74% of the sample.

This indicates that for most individuals (over 80%), ecological awareness still significantly predicts behavior, but for a smaller group with advanced knowledge, the influence of awareness weakens.

This pattern suggests a ceiling effect: at higher levels of knowledge, individuals may already possess sufficient motivation, self-efficacy, and normative commitment to act, rendering additional awareness less impactful.

Figure 1 and Table 3 illustrate that as ecological knowledge increases, the slope of the awareness–behavior relationship flattens, especially beyond the Johnson–Neyman threshold.

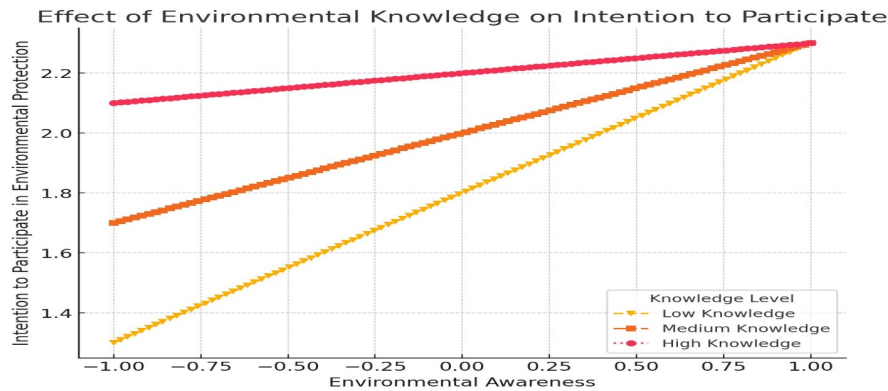


Figure 1. The moderating effect of environmental knowledge in the relationship between environmental awareness and protective behavior.

Table 3. Conditional effects of awareness across knowledge levels.

Ecological Knowledge	Effect	SE	t-value	p	LLCI*	ULCI**
−0.6089	0.6740	0.0847	7.9535	0.0000	0.5070	0.8409
0.0000	0.3973	0.0654	6.0711	0.0000	0.2684	0.5263
0.6089	0.1207	0.0892	1.3527	0.1775	−0.0551	0.2965
−1.5160	1.0861	0.1539	7.0566	0.0000	0.7828	1.3894
0.4840	0.1774	0.0817	2.1727	0.0308	0.0165	0.3384
0.5131	0.1642	0.0833	1.9705	0.0500	0.0000	0.3284
0.6090	0.1206	0.0892	1.3522	0.1777	−0.0552	0.2965
0.9840	−0.0497	0.1162	−0.4281	0.6690	−0.2786	0.1792

Notes: *LLCI = Lower Limit Confidence Interval of the Bootstrap Method; **ULCI = Upper Limit Confidence Interval of the Bootstrap Method.

These analyses indicate that the conditional effect of ecological awareness decreases as ecological knowledge increases. This effect is significantly strong when the ecological knowledge value is low or medium, but becomes insignificant when the value of knowledge exceeds a certain level (0.5131).

These results suggest that ecological knowledge plays an important moderating role in the relationship between ecological awareness and ecological protection behavior. As ecological knowledge increases, the effect of ecological awareness on ecological protection behavior diminishes, helping to regulate and optimize environmental protection actions (Figure 1).

The moderating effect of ecological knowledge has been confirmed in the relationship between ecological awareness and ecological protection behavior, with the conditional effects of ecological awareness presented in Table 4. Three conditions ($M \pm SD$, M) are provided based on the ecological knowledge values, and the conditional effects of ecological awareness at low ($M-1SD$), medium (M), and high ($M+1SD$) ecological knowledge are all significant. As eco-

logical knowledge increases, the conditional effect of ecological awareness decreases.

The significant region of the conditional effect has been determined through the Johnson-Neyman analysis. The conditional effect of ecological awareness is not significant for ecological knowledge values ranging from -1.15160 to -0.8232 , but it becomes significant once it exceeds -0.8232 . This represents the significant region for 88.4120% of the total survey participants. This means that as ecological knowledge increases, the conditional effect of ecological awareness decreases, but when the knowledge value is below -0.8232 , the conditional effect is no longer significant.

Figure 2 illustrates the conditional effect of ecological awareness by classifying ecological knowledge into three levels: high, medium, and low. In all three conditions, ecological protection behavior increases as ecological awareness rises. However, as ecological awareness increases, the slope of the increase in ecological protection behavior is steeper for those with high ecological knowledge compared to those with low ecological knowledge.

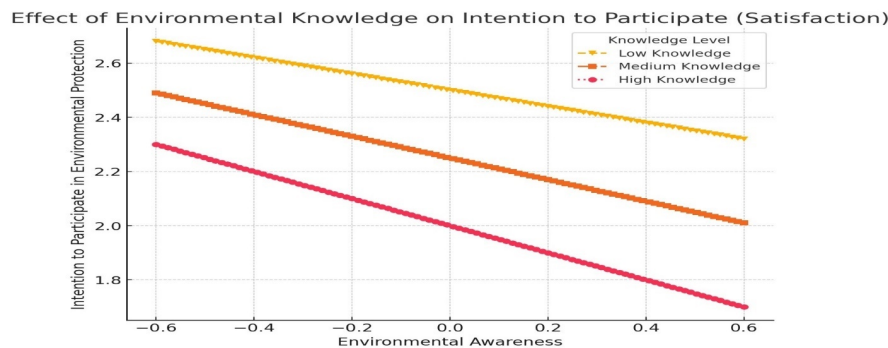


Figure 2. The moderating effect of environmental knowledge in the relationship between awareness and protective behavior.

Table 4. Johnson-Neyman analysis of the statistical significant region of the conditional effect.

Ecological Knowledge	Effect	F	t-Value	p	LLCI*	ULCI**
-1.5160	0.0022	0.1627	0.0138	0.9890	-0.3183	0.3228
-	-	-	-	-	-	-
-0.8232	-0.2099	0.1065	-1.9705	0.0500	-0.4198	0.0000
-0.7660	-0.2274	0.1025	-2.2190	0.0275	-0.4294	-0.0255
-	-	-	-	-	-	-
0.9840	-0.7633	0.1198	-6.3728	0.0000	-0.9993	-0.5273

Notes. *LLCI = Lower Limit of the 95% Confidence Interval (bootstrap); **ULCI = Upper Limit of the 95% Confidence Interval (bootstrap).

These results demonstrate that ecological knowledge plays an important moderating role in the relationship between ecological awareness and ecological protection behavior. When ecological knowledge is high, the effect of ecological awareness on ecological protection behavior decreases,

which helps regulate and optimize ecological protection actions.

To better understand the conditional indirect and direct effects in the relationship between ecological awareness and ecological protection behavior, the value of ecological

knowledge has been analyzed under three conditions (M \pm SD, M).

In the relationship between ecological awareness and ecological protection behavior, the conditional direct effect is significant when ecological knowledge is at low (M-1SD) and medium (M) levels. As ecological knowledge increases, the conditional direct effect decreases. However, this trend is no longer significant when ecological knowledge exceeds the medium level (M+1SD).

Additionally, the conditional indirect effect, through the pathway from ecological awareness \rightarrow ecological consciousness \rightarrow ecological protection behavior, is significant at all levels of ecological knowledge: low (M-1SD), medium (M), and high (M+1SD). As ecological knowledge increases, the conditional indirect effect also increases, and the mediating-moderating index [0.1136 (0.0421 ~ 0.1981)] is significant. This confirms that the mediating-moderating effect of ecological knowledge has been validated in the impact of ecological awareness on ecological protection behavior through ecological consciousness.

4.4. Moderated Mediation Mechanism

To deepen our understanding of the interaction effect, the analysis examined both direct and indirect pathways across three conditions: low (M-1SD), medium (M), and

high (M+1SD) ecological knowledge.

- The direct effect of awareness on behavior was significant at low and medium levels of knowledge but not significant at the high level.
- The indirect effect—through ecological consciousness—increased with knowledge, suggesting that higher knowledge enhances the mediating influence of ecological consciousness.
- The moderated mediation index was significant (Index = 0.1136, BootCI [0.0421, 0.1981], confirming that ecological knowledge not only moderates the direct path but also strengthens the mediated path through ecological consciousness.

This dual-pathway moderation highlights a nuanced mechanism: ecological knowledge channels the influence of awareness away from direct behavior and toward deeper internal processes (e.g., values, norms), which then result in action.

The results in **Table 5** demonstrate that ecological knowledge moderates the relationship between ecological awareness and ecological protection behavior. As ecological knowledge increases, the conditional indirect effect also increases, confirming the mediating-moderating effect of ecological knowledge.

Table 5. Conditional direct and indirect effects.

Conditional Direct Effect of Ecological Awareness on Ecological Protection Behavior						
Ecological Knowledge	Effect	SE	t-value	p	LLCI*	ULCI**
-0.6089	0.6740	0.0847	7.9535	0.0000	0.5070	0.8409
0.0000	0.3973	0.0654	6.0711	0.0000	0.2684	0.5263
0.6089	0.1207	0.0892	1.3527	0.1775	-0.0551	0.2965
Conditional Indirect Effect of Ecological Awareness on Ecological Protection Behavior						
Ecological Knowledge	Effect	BootSE	BootLLCI*	BootULCI**		
-0.6089	0.1022	0.0421	0.0273	0.1941		
0.0000	0.1713	0.0400	0.1005	0.2567		
0.6089	0.2405	0.0510	0.1479	0.3467		
Mediating-Moderating Effect Index						
Ecological Knowledge	Index	BootSE	BootLLCI*	BootULCI**		
-	0.1136	0.0399	0.0421	0.1981		

Notes. *LLCI = Lower Limit of the 95% Confidence Interval (bootstrap); **ULCI = Upper Limit of the 95% Confidence Interval (bootstrap).

5. Discussion

This study was conducted to examine the conditional indirect effect of ecological knowledge in the relationship be-

tween ecological awareness, ecological consciousness, and ecological protection behavior among farmers, workers, civil servants, teachers, students, and pupils in Vietnam. Based on the research results, the following discussions are presented:

Firstly, Pearson correlation analysis revealed a significant correlation between ecological awareness, ecological consciousness, ecological knowledge, and ecological protection behavior. This indicates that factors such as awareness, consciousness, and knowledge all influence ecological protection behavior, suggesting that interventions aimed at enhancing ecological protection behavior can be developed by targeting these factors.

Secondly, ecological consciousness plays an intermediary role in the relationship between ecological awareness and ecological protection behavior. This result aligns with previous studies that have highlighted the mediating role of consciousness in the relationship between awareness of social issues and real-world actions. Therefore, since ecological consciousness is a mediator between awareness and ecological protection behavior, strategies to enhance ecological consciousness should be implemented to encourage ecological protection behavior.

Thirdly, the conditional effect of ecological knowledge in the relationship between ecological awareness and ecological protection behavior is significant when ecological knowledge is at low and medium levels, and this effect decreases as ecological knowledge increases. Moderation analysis indicates that the influence of ecological awareness on ecological protection behavior differs between individuals with high and low ecological knowledge. This suggests that interventions to improve ecological protection behavior can be developed through enhancing ecological knowledge.

Fourthly, in the relationship between ecological consciousness and ecological protection behavior, the conditional effect of ecological knowledge is significant at all levels—low, medium, and high. As ecological knowledge increases, the effect of ecological consciousness on ecological protection behavior also increases. This suggests that improving ecological knowledge can enhance the effectiveness of ecological consciousness, thus promoting ecological protection behavior.

Fifthly, in the impact of ecological awareness on ecological protection behavior through ecological consciousness, there is a mediating-moderating effect of ecological knowledge. This result aligns with the “buffering” effect observed in psychological studies, where knowledge of an issue helps mitigate the negative effects of low awareness of that issue. Therefore, strategies should be developed to im-

prove participants’ ecological knowledge, thereby reducing negative factors and enhancing ecological protection behavior. Propaganda and education should raise awareness of environmental protection and resource sustainability, emphasizing the responsible use of natural resources and waste management^[12,33].

Despite these findings, this study is not without limitations. First, the use of a self-report questionnaire as the primary data collection method may lead to social desirability bias, where participants provide answers they perceive as favorable rather than accurate reflections of their behavior. Second, convenience sampling and the focus on a limited geographic area in Vietnam may restrict the generalizability of the findings to broader populations. Third, the cross-sectional nature of the study limits the ability to establish causal relationships between variables. Future research should consider using longitudinal designs or experimental methods to validate the observed relationships over time. Additionally, incorporating qualitative approaches such as interviews or focus groups could provide deeper insights into the subjective meanings behind ecological attitudes and behaviors.

These findings highlight the crucial role of ecological knowledge in moderating and enhancing ecological protection behavior, especially when combined with ecological consciousness and awareness. The development of education and communication programs aimed at improving ecological knowledge is essential to promote ecological protection actions in the community.

6. Conclusion

This study contributes to the existing literature by examining the mediating and moderating effects of ecological knowledge in the relationship between ecological awareness, ecological consciousness, and ecological protection behavior. The results confirm the theoretical relevance of these variables and provide empirical evidence from the Vietnamese context, covering diverse groups such as farmers, workers, civil servants, teachers, students, and pupils.

Several directions for future research are proposed based on the study’s limitations and findings. First, while this study identifies key psychological and cognitive factors influencing ecological protection behavior, it does not fully

address the barriers that limit individuals' engagement in such behaviors. Future research should explore these obstacles in greater depth, including economic constraints, time availability, access to environmental information, and social or institutional support. Qualitative research methods, such as in-depth interviews or focus groups, could be employed to gain richer insights into the lived experiences and coping strategies of different demographic groups.

Second, the findings suggest a differential effect of ecological awareness depending on the level of ecological knowledge and the presence of ecological consciousness. Specifically, the direct influence of awareness decreases as knowledge increases, while the indirect influence through consciousness becomes stronger. To understand this dynamic more clearly, future studies should adopt longitudinal designs to track changes in awareness, knowledge, and behavior over time. Structural equation modeling or experimental designs may also help clarify causal mechanisms and test the robustness of the proposed moderated mediation model.

In conclusion, the findings underscore the critical role of both ecological knowledge and consciousness in shaping ecological protection behavior. It is essential to develop and implement targeted education and communication programs that simultaneously raise awareness, build ecological knowledge, and foster ecological consciousness. Doing so will help cultivate sustainable behavioral changes and strengthen community engagement in ecological protection in the long term.

Author Contributions

Conceptualization, L.T.C.T.; methodology, L.T.G.; software, L.T.G.; validation, L.T.C.T., D.N.T., and N.T.H.; formal analysis, N.V.T.; investigation, N.V.T.; resources, L.T.C.T.; data curation, L.T.C.T.; writing—original draft preparation, L.T.C.T.; writing—review and editing, N.V.T.; All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The data presented in this study may be obtained on request from the corresponding author.

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Conflicts of Interest

The authors declare no conflict of interest.

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