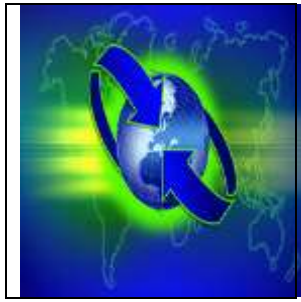




**Participation in Environmental Protection and Conservation Practices as Predictors of Secondary School Students' Awareness of Terrestrial Ecosystem Sustainability in Cross River State, Nigeria**

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## **Abstract**

This study examined the extent to which secondary school students' participation in environmental protection and conservation practices predicts their awareness of terrestrial ecosystem sustainability in Cross River State, Nigeria. Awareness is the cognitive foundation of environmentally responsible behavior, yet little is known about the participatory practices that build it among students in this ecologically strategic but under-researched state. Two research questions and two null hypotheses guided the study. The correlational survey design was adopted. From a population of 25,998 Senior Secondary School Two students, a sample of 394 was drawn using Taro Yamane's formula and multistage sampling. Two validated instruments, the Students' Environmental Protection and Conservation Practices Questionnaire (SEPCPQ) and the Students' Awareness, Perception and Attitude towards Terrestrial Ecosystem Sustainability Questionnaire (SAPATESQ), with overall reliabilities of 0.81 and 0.82, were used for data collection. Linear regression answered the research questions while the associated regression ANOVA tested the hypotheses at the 0.05 level. Results showed that participation in environmental protection practices predicted 36.3% of the variance in awareness ( $R = .602$ ;  $F(1,392) = 222.946$ ;  $p < .05$ ), and participation in conservation practices predicted 34.6% ( $R = .588$ ;  $F(1,392) = 207.312$ ;  $p < .05$ ); both predictions were statistically significant. It was concluded that participatory environmental practices significantly build students' awareness of terrestrial ecosystem sustainability, and recommendations were made accordingly.

*Keywords: Environmental protection, environmental conservation, awareness, terrestrial ecosystem sustainability, secondary school students, Cross River State*

## **Introduction**

Awareness is where environmental responsibility begins. Before a young person can perceive an ecological threat as urgent, form a favorable attitude towards conservation, or act to protect the environment, that person must first know that the environment exists as a system, understand the issues that endanger it, and grasp why its preservation matters. Environmental

awareness which is the knowledge of ecosystems, of the issues affecting them, and of the importance of conserving natural resources is thus the cognitive foundation on which all other environmentally responsible dispositions and behaviors are built. Where awareness is high, learners are positioned to perceive, value and act; where it is low, apathy and environmentally harmful practices tend to follow.

Globally, the cultivation of environmental awareness among young people has become a central educational priority. Education for Sustainable Development, championed by UNESCO (2023), places environmental literacy and action-oriented learning at the heart of schooling, and the OECD (2023) reports that the overwhelming majority of education systems now treat environmental sustainability as a key priority, even as many struggle to translate learners' awareness into agency. Recent reviews confirm that environmental education can raise sustainability awareness substantially when it engages learners actively rather than transmitting facts passively (Mukama & Andersson, 2024; Sass, Boeve-de Pauw & Van Petegem, 2025).

Awareness, however, is not generated by instruction alone; it is strongly shaped by participation. When students take part in tangible environmental protection practices clean-up campaigns, tree planting, pollution control, anti-littering drives and in conservation practices such as afforestation, soil and water preservation, biodiversity mapping and eco-club activities, they encounter ecological realities directly and build durable, experiential knowledge. Ardoin, Bowers and Gaillard (2023), in a systematic review, found that hands-on civic and environmental engagement produces measurable cognitive and dispositional gains, and a recent study reported that the more students participate in environmental programmes, the better their environmental knowledge and behaviour (Saputra & Wahyuni, 2024). Participation, in short, is a powerful route to awareness. Terrestrial ecosystems such as forests, grasslands, wetlands, and savannas are the primary focus of this study because they provide carbon sequestration, soil fertility, water regulation, and habitat, and because they are under acute threat. The United Nations Environment Programme (2023) estimates that Africa loses up to four million hectares of forest annually, with

West and Central Africa being the most severely affected. Terrestrial ecosystem sustainability the capacity of land-based ecosystems to maintain their structure, functions, and productivity over time (IPBES, 2022) depends, in the long run, on whether the next generation is aware enough to safeguard them. Forests, for instance, play vital roles in regulating weather and climate conditions, which subsequently influence sustainable agriculture, the stability of water bodies, flood mitigation, wildlife preservation, and annual rainfall patterns (Odok & Oyamo, 2022).

Land degradation from intensive farming and deforestation builds up a heavy "land debt" that puts global biodiversity targets at risk. Babur et al. (2025) point out that healthy soil is the real foundation of land stability. Their research highlights that smart, deliberate conservation—like planting native trees to restore forests—significantly enriches soil carbon and nitrogen. By reviving these damaged lands, we turn them back into vital carbon sinks that pull pollution right out of the air.

Nowhere in Nigeria is this more consequential than Cross River State, which holds over half of the country's remaining tropical rainforest and globally significant biodiversity, including the endangered Cross River gorilla. Yet Iwara and Ubi (2023) observe that student participation in the state's conservation programmes is inconsistent and uncoordinated, especially in rural and semi-urban schools, and Ushie and Okon (2023) report sharp urban–rural disparities in eco-club activity and awareness. Whether, and how strongly, students' participation in environmental protection and conservation practices actually predicts their awareness of terrestrial ecosystem sustainability in this strategic state has not been established empirically. This study addresses that question.

### **Statement of the Problem**

The sustainability of Cross River State's terrestrial ecosystems depends heavily on whether its young people are aware of the ecological value of the forests, soils and wildlife around them and of the threats these face. Awareness is the cognitive precondition for conservation: students

who do not know that deforestation, habitat loss and soil degradation endanger their environment can hardly be expected to perceive these as urgent or to act against them.

Ideally, secondary school students in so ecologically rich a state would be deeply aware of terrestrial ecosystem issues, that awareness having been built through active participation in environmental protection and conservation practices. In reality, available evidence suggests that participation is limited, uneven and poorly coordinated, particularly in rural and semi-urban schools, and that awareness is correspondingly patchy. While studies in urban centres elsewhere in Nigeria report encouraging levels of participation and awareness, the situation in Cross River State remains unclear and under-researched.

More specifically, although environmental awareness is widely discussed, there is little empirical evidence on the extent to which the two principal forms of student environmental engagement protection practices and conservation practices actually predict awareness of terrestrial ecosystem sustainability in this context. Few studies isolate these participatory predictors, and fewer still quantify how much of the variance in awareness they explain. This leaves educators and policy makers without the evidence they need to design participation-based strategies for building awareness.

The problem of this study, therefore, is the uncertainty surrounding the predictive relationship between students' participation in environmental protection and conservation practices and their awareness of terrestrial ecosystem sustainability in Cross River State. Put as a question: to what extent do secondary school students' participation in environmental protection and conservation practices predict their awareness of terrestrial ecosystem sustainability in Cross River State, Nigeria?

### **Purpose of the Study**

The purpose of this study was to examine the extent to which secondary school students' participation in environmental protection and conservation practices predicts their awareness of terrestrial ecosystem sustainability in Cross River State, Nigeria.

Specifically, the study sought to:

- 1 Determine the extent to which secondary school students' participation in environmental protection practices predicts their awareness of terrestrial ecosystem sustainability.
- 2 Ascertain the extent to which secondary school students' participation in environmental conservation practices predicts their awareness of terrestrial ecosystem sustainability.

### **Research Questions**

The following research questions were posed;

- 1 To what extent does participation of secondary school students in environmental protection practices predict their awareness of terrestrial ecosystem sustainability?
- 2 To what extent does participation of secondary school students in environmental conservation practices predict their awareness of terrestrial ecosystem sustainability?

### **Research Hypotheses**

The following null hypotheses were formulated and tested at the 0.05 level of significance:

**HO1:** Participation of secondary school students in environmental protection practices does not significantly predict their awareness of terrestrial ecosystem sustainability.

**HO2:** Participation of secondary school students in environmental conservation practices does not significantly predict their awareness of terrestrial ecosystem sustainability.

### **Literature review**

Environmental awareness refers to the knowledge, values and skills that enable individuals to identify environmental challenges and understand their implications (Okoye & Edem, 2023; UNESCO, 2023). In the context of terrestrial ecosystems, it encompasses students' understanding of land-based systems, the issues affecting them such as deforestation and biodiversity loss, and the importance of conserving natural resources for the future. Okoye and Edem (2023) found that students with high environmental awareness are better able to identify ecological problems and their long-term consequences, while Oghenekaro and Yusuf (2023) reported that once students get their hands dirty whether by planting trees, organizing waste-

sorting drives, or running school sanitation projects environmental conservation stops being a boring textbook chapter and starts making real sense. Findings by Velempini (2025) underline a simple truth: active involvement is what transforms students from passive listeners into genuinely aware, eco-conscious individuals. When young people take part in real-world protection efforts, caring for the environment feels personal, urgent, and necessary.

Research confirms that aware students are more likely to participate in afforestation and eco-sanitation. When students get environmental awareness interventions are most effective when framed around tangible local ecosystems (such as community forests, soil conservation, and river basin restoration). Experiential engagement directly enhances community support for SDG 15 (Life on Land) targets, including halting land degradation and conserving biodiversity (McLeod et al., 2024).

Recent studies move beyond abstract sustainability goals toward operational stewardship. Conceptualizing stewardship as a relational practice combining environmental care, local knowledge, and capacity for agency provides a robust framework for managing private lands, restoring degraded terrestrial habitats, and protecting forest ecosystems (McLeod et al., 2024). Systematic literature mapping shows that integrating environmental awareness into educational contexts using experiential, learner-centered, and technology-enhanced frameworks significantly bridges the gap between passive knowledge and active pro-environmental behaviors (Fadly, 2026). Relatedly, a systematic review of pedagogical strategies for teaching environmental literacy found that secondary school approaches combining field-based, participatory activities with classroom instruction produced stronger and more durable gains in environmental literacy than lecture-based approaches alone (Xiong & Lebeaume, 2025).

Environmental awareness when paired with active stewardship and community involvement directly supports long-term terrestrial ecosystem health, rather than treating ecological knowledge as mere facts to memorize; contemporary research emphasizes personal connections to nature by engaging the psychomotor domain in protecting terrestrial ecosystems.

True progress happens when local knowledge, emotional connection to the land, and personal responsibility come together. This combination empowers communities to protect forest lands, restore damaged soil, and sustainably manage local habitats (McLeod et al., 2024).

Systematic reviews show that teaching methods make all the difference. Experiential learning where students engage directly with local environment issues significantly increases pro-environmental behavior compared to traditional lecture-based methods (Fadly, 2026). Environmental awareness campaigns are most effective when grounded in familiar, local ecosystems like community forests and nearby waterways (McLeod et al., 2024). By empowering communities at the grassroots level, these initiatives foster long-term commitment to biodiversity conservation and land restoration, directly advancing global goals such as UN SDG 15 (Life on Land) (United Nations, 2023).

A consistent body of evidence links participation in environmental protection practices to heightened awareness. Underlining the broader case for structured environmental protection education, Kujoh, Ojong, Effiom and Dan (2020) found that environmental health education significantly promoted students' understanding of and commitment to protecting their surroundings in Nigerian universities, arguing that such education should not remain fragmented but be built into the core of formal instruction if its impact on sustainable environmental behaviour is to be felt. Agyeman and Tetteh (2023) found that participation in protection practices such as tree nursery management, soil conservation and waste segregation significantly influenced Ghanaian students' awareness of terrestrial ecosystem sustainability, with participants demonstrating deeper understanding of biodiversity threats.

Eze and Onuoha (2023) similarly reported that Nigerian students who engaged in erosion control, reforestation and pollution management had significantly higher environmental awareness. Adewole and Ude (2024), using multiple regression, found participation in protection practices a significant predictor of awareness, accounting for a substantial share of the variance directly paralleling the present study's concern. At the tertiary level, Kujoh, Ojong, Effiom and

Dan (2020) similarly found that environmental health education significantly shaped Nigerian university students' orientation towards environmental protection, reinforcing that structured environmental-protection instruction and practice, from secondary through tertiary education, builds the awareness and disposition needed for responsible environmental conduct.

Within Cross River State, Ushie and Okon (2023) found that students who regularly participated in eco-clubs and related protection activities reported significantly higher awareness of ecological problems than non-participants, though with marked urban–rural disparities. This local pattern is corroborated by Omari, Omoogun and Effiom (2019), who found that mass media-based environmental awareness strategies significantly shaped farmers' attitudes towards deforestation in Southern Cross River State, suggesting that both structured school-based participation and community-level awareness channels operate together to shape environmental consciousness within the state.

The broader literature on participation and pro-environmental outcomes (Saputra & Wahyuni, 2024; Ardoin et al., 2023) supports the mechanism: tangible engagement builds experiential knowledge that classroom instruction alone cannot provide. When students actively participate in environmental protection whether by sorting waste, planting trees, or cleaning up neighborhood spaces, environmental conservation moves out of the classroom into real life. Recent research consistently shows that getting directly involved is what transforms students from passive listeners into becoming more aware and proactive towards environmental consciousness.

Gupta et al. (2024) examined how school-based eco-activities influence Secondary School environmental habits and awareness. Using a descriptive survey design, they found that students who regularly took part in practical tasks like waste segregation, energy-saving initiatives, and tree planting showed much higher environmental literacy than those who did not. The authors noted that physically doing the work builds a bridge between classroom theory and everyday awareness, helping young people build lasting sustainable habits.

Taking a closer look at outdoor learning, Suarlin (2023) tested how hands-on field projects affect secondary school learners using a quasi-experimental setup. Students engaged directly with school gardens and local conservation efforts, leading to a marked leap in their environmental awareness scores. Suarlin emphasized that working directly within local ecosystems provides immediate, practical reinforcement turning abstract environmental issues into things students feel personally responsible for. While Velepini (2025) highlighted how practical environmental education drives the UN Sustainable Development Goals among youth. The study showed that activities like community sanitation, anti-plastic drives, and habitat restoration give students a real sense of agency. Rather than just memorizing environmental facts, active participation builds self-efficacy and transforms students into active defenders of their local environments.

Conservation practices such as afforestation, soil and water preservation, biodiversity mapping, school gardens and eco-clubs have likewise been linked to awareness. Agyeman and Tetteh (2023) found that student participation in conservation practices such as soil-erosion control, school gardens and tree-nursery establishment had a significant positive effect on environmental awareness, with engaged students showing deeper understanding of ecological processes. Eze and Onuoha (2023) reported that participation in biodiversity mapping, habitat preservation and tree planting was associated with significantly higher awareness of terrestrial ecosystem degradation, especially in schools with active eco-clubs.

These findings are consistent with the experiential and participatory emphasis of recent environmental-education research (Putri & Hamidah, 2025; Sass et al., 2025), which shows that hands-on conservation activity fosters environmental knowledge and identity. They also align with Ushie and Okon's (2023) Cross River evidence that conservation-oriented eco-club participation raises awareness. What remains insufficiently established and what this study provides is a direct, quantified estimate of how much conservation participation predicts awareness of terrestrial ecosystem sustainability in this specific context. Conservation strategies

are moving away from older, "keep-out" preservation models toward hands-on, shared management. People are far more likely to help protect local forests and nature reserves when they understand conservation policies, have access to formal education, and feel their voices genuinely matter in local governance (Gotyi et al., 2025; Syamsiyah et al., 2025).

When people gain a solid grasp of how local ecosystems work, they are much more likely to reduce waste, conserve energy, and harvest local resources sustainably (Gupta et al., 2024; Qudrat-Ullah, 2025). Strong, inspiring leaders within a community play a vital role in turning individual awareness into collective action. Leaders who listen, collaborate, and motivate make it easier for neighborhoods to organize, advocate for better environmental policies, and build long-term resilience (Rojas Casarrubias et al., 2025). In rural areas and near nature reserves, pairing environmental awareness with community-driven tourism gives locals people a clear reason to protect their surroundings. When conservation efforts respect local culture and bring tangible economic benefits, active participation increases significantly (Obradović Strålman et al., 2025).

The literature establishes that awareness is the cognitive foundation of environmental responsibility, and that participation in both protection and conservation practices tends to build it. However, most studies examine one form of participation, are situated outside Cross River State, or stop at establishing association without quantifying prediction. Few isolate protection and conservation practices as distinct predictors of awareness of terrestrial ecosystem sustainability, and fewer still do so in the ecologically strategic context of Cross River State. The present study addresses this gap by providing regression-based evidence on the predictive contribution of each form of participation to students' awareness.

## **Methodology**

The study adopted the correlational survey research design. According to Nworgu (2015), the correlational survey design seeks to establish the relationships that exist between two or more variables and to indicate the direction as well as the magnitude of such relationships. The design was considered appropriate because the study sought to establish the direction and magnitude of

the relationship between secondary school students' participation in environmental protection and conservation practices and their awareness, perception and attitude towards terrestrial ecosystem sustainability, without manipulating any variable.

The study was conducted in Cross River State, Nigeria, which lies within the South-South geopolitical zone and the tropical rainforest belt. The state hosts over fifty per cent of Nigeria's remaining tropical rainforest and internationally significant biodiversity, including the Cross River National Park and the Afi Mountain Wildlife Sanctuary, making it an ecologically strategic and environmentally sensitive setting for the study. Its eighteen Local Government Areas are grouped into three education zones: Calabar, Ikom and Ogoja.

The population comprised 25,998 Senior Secondary School Two (SS2) students in the 298 public secondary schools across the three education zones in Cross River State for the 2024/2025 academic session. The sample consisted of 394 SS2 students, determined using Taro Yamane's (1967) formula and drawn through a multistage sampling procedure. The population was first stratified into the three education zones; proportionate sampling was then used to select thirty-five public senior secondary schools from across the zones, as shown in Table 1, and, in turn, the proportionate number of students from each zone.

**Table 1: Distribution of the Population and Sample of Schools by Education Zone**

| Education Zone | Population of Public Senior<br>Secondary Schools | Sample of Schools<br>Selected | Estimated Sample of<br>Students* |
|----------------|--------------------------------------------------|-------------------------------|----------------------------------|
| Calabar        | 94                                               | 11                            | 124                              |
| Ikom           | 112                                              | 13                            | 146                              |
| Ogoja          | 92                                               | 11                            | 124                              |
| Total          | 298                                              | 35                            | 394                              |

Two researcher-developed instruments were used. The Students' Environmental Protection and Conservation Practices Questionnaire (SEPCPQ) contained forty items in two clusters of twenty items each, eliciting data on students' level of participation in environmental protection practices (Cluster A) and environmental conservation practices (Cluster B). The Students'

Awareness, Perception and Attitude towards Terrestrial Ecosystem Sustainability Questionnaire (SAPATESQ) contained thirty items in three clusters of ten items each, measuring awareness (Cluster I), perception (Cluster II) and attitude (Cluster III). Both instruments used a four-point scale of Very High Extent (4), High Extent (3), Low Extent (2) and Very Low Extent (1).

The instruments were face-validated by three experts from the University of Nigeria, Nsukka—two from Geography and Environmental Education in the Department of Social Science Education and one from Measurement and Evaluation in the Department of Science Education. Reliability was established through a trial test on thirty SS2 students in Akwa Ibom State, using the Cronbach alpha method appropriate for the polytomously scored items. The SEPCPQ clusters returned coefficients of 0.79 and 0.82 (overall 0.81), and the SAPATESQ clusters returned 0.77, 0.80 and 0.83 (overall 0.82), indicating that the instruments were reliable.

The instruments were administered directly by the researcher with the assistance of six trained research assistants, who collected and retrieved the questionnaires on the spot, achieving a one hundred per cent return rate of 394 copies. Linear regression analysis was used to answer the research questions involving a single predictor, and multiple regression analysis for those involving the two predictors jointly; the correlation coefficient ( $R$ ) and coefficient of determination ( $R^2$ ) were used to answer the research questions, while the associated regression ANOVA was used to test the null hypotheses at the 0.05 level of significance.

## **Results**

### ***Research Question One***

To what extent does participation of secondary school students in environmental protection practices predict their awareness of terrestrial ecosystem sustainability?

Table 2 shows a correlation coefficient ( $R$ ) of .602 between students' participation in environmental protection practices and their awareness of terrestrial ecosystem sustainability, with a coefficient of determination ( $R^2$ ) of .363. This implies that participation in environmental

protection practices predicts 36.3% of the variance in students' awareness of terrestrial ecosystem sustainability.

**Table 2: Regression analysis of the extent to which participation in environmental protection practices predicts awareness of terrestrial ecosystem sustainability**

| Model | R    | R Square | Adj. R Square | Std. Error | F       | df1 | df2 | Sig. |
|-------|------|----------|---------------|------------|---------|-----|-----|------|
| 1     | .602 | .363     | .361          | .29516     | 222.946 | 1   | 392 | .000 |

*Key: R = Correlation coefficient; R<sup>2</sup> = Coefficient of determination. Predictor(s): Students' Participation in Environmental Protection Practices (SPEPP).*

*Source: Field Survey (2025)*

**HO1:** Participation of secondary school students in environmental protection practices does not significantly predict their awareness of terrestrial ecosystem sustainability.

**Table 3: Regression ANOVA of the significance of the prediction of awareness by participation in environmental protection practices**

| Model      | Sum of Squares | df  | Mean Square | F       | Sig.  |
|------------|----------------|-----|-------------|---------|-------|
| Regression | 18.105         | 1   | 18.105      | 222.946 | .000b |
| Residual   | 31.833         | 392 | .081        |         |       |
| Total      | 49.938         | 393 |             |         |       |

*a. Dependent Variable: Awareness of Terrestrial Ecosystem Sustainability (ATES). b. Predictor(s): Students' Participation in Environmental Protection Practices (SPEPP).  $\alpha = 0.05$ .*

*Source: Field Survey (2025)*

Table 3 shows that participation in environmental protection practices significantly predicts awareness of terrestrial ecosystem sustainability,  $F(1, 392) = 222.946$ ,  $p = .000$ . Since the probability value of .000 is less than 0.05, the null hypothesis (HO1) was rejected. It was therefore concluded that participation in environmental protection practices significantly predicts students' awareness of terrestrial ecosystem sustainability.

### **Research Question Two**

To what extent does participation of secondary school students in environmental conservation practices predict their awareness of terrestrial ecosystem sustainability?

**Table 4: Regression analysis of the extent to which participation in environmental conservation practices predicts awareness of terrestrial ecosystem sustainability**

| Model | R    | R Square | Adj. R Square | Std. Error | F Change | df1 | df2 | Sig. |
|-------|------|----------|---------------|------------|----------|-----|-----|------|
| 1     | .588 | .346     | .344          | .28866     | 207.312  | 1   | 392 | .000 |

Key:  $R$  = Correlation coefficient;  $R^2$  = Coefficient of determination. Predictor(s): Students' Participation in Environmental Conservation Practices (SPECP).

Source: Field Survey (2025)

Table 4 shows a correlation coefficient ( $R$ ) of .588 between students' participation in environmental conservation practices and their awareness of terrestrial ecosystem sustainability, with a coefficient of determination ( $R^2$ ) of .346. This implies that participation in environmental conservation practices predicts 34.6% of the variance in students' awareness of terrestrial ecosystem sustainability.

**HO2:** Participation of secondary school students in environmental conservation practices does not significantly predict their awareness of terrestrial ecosystem sustainability.

**Table 5: Regression ANOVA of the significance of the prediction of awareness by participation in environmental conservation practices**

| Model      | Sum of Squares | df  | Mean Square | F       | Sig.  |
|------------|----------------|-----|-------------|---------|-------|
| Regression | 17.274         | 1   | 17.274      | 207.312 | .000b |
| Residual   | 32.663         | 392 | .083        |         |       |
| Total      | 49.938         | 393 |             |         |       |

a. Dependent Variable: Awareness of Terrestrial Ecosystem Sustainability (ATES). b. Predictor(s): Students' Participation in Environmental Conservation Practices (SPECP).  $\alpha = 0.05$ .

Source: Field Survey (2025)

Table 5 shows that participation in environmental conservation practices significantly predicts awareness of terrestrial ecosystem sustainability,  $F(1, 392) = 207.312$ ,  $p = .000$ . Since

the probability value of .000 is less than 0.05, the null hypothesis (H<sub>02</sub>) was rejected. It was therefore concluded that participation in environmental conservation practices significantly predicts students' awareness of terrestrial ecosystem sustainability.

### **Discussion of Findings**

The study found that participation in environmental protection practices significantly predicted students' awareness of terrestrial ecosystem sustainability, explaining 36.3% of its variance. This finding affirms the theoretical expectation, drawn from Hungerford and Volk (1990) and Bandura (1986), that hands-on engagement with environmental realities builds the cognitive foundation of awareness, since both frameworks position direct, socially situated experience as more durable than passive instruction. It agrees with Agyeman and Tetteh (2023) and Eze and Onuoha (2023), who found protection practices significantly associated with awareness, and with Adewole and Ude (2024), who identified protection participation as a significant predictor of awareness. The Cross River evidence of Ushie and Okon (2023) is likewise corroborated. This result is further reinforced by Okoye and Edem (2023), who found that students with high environmental awareness were correspondingly better able to identify ecological problems and their consequences. Oghenekaro and Yusuf (2023) who studied Nigerian evidence showed that once students engage directly in activities such as tree planting and waste-sorting, environmental conservation ceases to be an abstract classroom topic and becomes personally meaningful. Velepini (2025) and Suarlin (2023) offer a plausible explanation for the size of the effect obtained here: hands-on protection activities give students a sense of agency and self-efficacy that lecture-based instruction cannot easily replicate, turning abstract environmental facts into lived, felt experience. Gupta et al. (2024) similarly found that students who regularly undertook practical protection tasks such as waste segregation and energy-saving initiatives displayed markedly higher environmental literacy than their non-participating peers, a pattern that closely mirrors the substantial variance explained in the present study. At the tertiary level, Kujoh, Ojong, Effiom and Dan (2020) found that environmental

health education significantly shaped Nigerian university students' orientation towards environmental protection, suggesting that the protection-awareness pathway identified here among secondary school students persists, and may even strengthen, into higher education. Within Cross River State specifically, the present finding extends Iwara and Ubi's (2023) observation that student participation in the state's conservation and protection programmes has generally been inconsistent and uncoordinated: where such participation does occur in a structured, sustained way, as captured by the SEPCPQ in this study, it appears to translate into a substantial, measurable gain in awareness.

Participation in conservation practices similarly and significantly predicted awareness, explaining 34.6% of its variance. This is consistent with Agyeman and Tetteh (2023), who found conservation participation significantly raised awareness, and with the experiential-learning emphasis of recent reviews (Sass et al., 2025; Putri & Hamidah, 2025). It also corroborates Omari, Omoogun and Effiom's (2019) Cross River State evidence that community- and media-based environmental awareness strategies significantly shaped attitudes towards deforestation, indicating that the awareness-building power of conservation-oriented engagement documented here at the school level operates alongside, and is reinforced by, similar processes at the community level within the same state.

The finding is further consistent with McLeod et al.'s (2024) systematic scoping review, which reconceptualises environmental stewardship as a relational practice combining ecological care, local knowledge and a sense of agency; the conservation practices measured in this study, including school gardens, biodiversity mapping and eco-club activities, are precisely the kind of stewardship-building experience McLeod et al. describe. Gotyi et al. (2025) and Syamsiyah et al. (2025) add a further dimension, showing that people are more likely to protect local forests and reserves when they understand conservation policy, have access to formal education, and feel their voices matter in local decision-making, a mechanism that plausibly extends to school-based conservation participation, where students who take part in eco-club decision-making may

develop precisely this sense of policy understanding and voice. Similarly, Qudrat-Ullah (2025) found that a solid grasp of how local ecosystems function is associated with more sustainable resource use, aligning with the substantial share of variance in awareness explained by conservation participation in this study. Obradović Strålman et al. (2025) further show that conservation efforts that are locally grounded and culturally respectful attract markedly higher active participation, a pattern consistent with the present study's Cross River-specific findings and with Ushie and Okon's (2023) observation of eco-club participation raising awareness in this same state.

The closeness of the two coefficients of determination (36.3% and 34.6%) indicates that protection and conservation practices are comparably powerful routes to awareness, each accounting for roughly a third of its variance, a substantial contribution for a single class of predictor. This near-parity is theoretically expected under Hungerford and Volk's (1990) model, in which awareness is generated by direct encounter with environmental issues regardless of whether that encounter takes a protective form, combating an existing threat, or a conservational form, proactively safeguarding a resource; both, in Bandura's (1986) social cognitive terms, provide the modelling and experiential reinforcement through which awareness is learned. The pattern also mirrors Ardoin, Bowers and Gaillard's (2023) systematic review finding that hands-on civic and environmental engagement, across a range of specific activity types, produces broadly comparable cognitive gains, and Saputra and Wahyuni's (2024) finding that the sheer extent of participation in environmental programmes, more than the specific type of programme, predicts environmental knowledge and behaviour.

Taken together with the wider literature on environmental-education pedagogy, these findings carry a clear implication for how participation should be organised. Fadly's (2026) systematic mapping of environmental-awareness research found that experiential, learner-centred and technology-enhanced approaches most effectively bridge the gap between passive knowledge and active pro-environmental behaviour, while Xiong and Lebeaume (2025) similarly found that

combining field-based, participatory activity with classroom instruction produces stronger and more durable environmental-literacy gains than either approach alone. Mukama and Andersson (2024) add that this experiential emphasis can be further strengthened, rather than replaced, by digital tools, suggesting that Cross River State schools seeking to build on the present findings need not choose between hands-on participation and technology-enhanced instruction. Rojas Casarrubias et al. (2025) further note that strong, engaged local leadership is often what determines whether individual student awareness translates into collective community action, pointing to school leadership and eco-club patronage as a lever policymakers in the state could strengthen directly.

Taken together, the findings establish that participatory environmental practices are significant predictors of awareness of terrestrial ecosystem sustainability among secondary school students in Cross River State. The remaining unexplained variance (around two-thirds) points to the role of other factors, curriculum quality, teacher preparation, media exposure and home background, consistent with the OECD's (2023) observation that awareness has multiple determinants, and with UNEP's (2023) and IPBES's (2022) broader observations that terrestrial ecosystem sustainability outcomes are shaped by an interacting web of educational, institutional and biophysical factors rather than by any single lever. Nonetheless, the evidence is clear that increasing students' participation in both protection and conservation practices is an effective, and comparatively tractable, strategy for building environmental awareness in this ecologically strategic state.

## **Conclusion**

The study concludes that secondary school students' participation in environmental protection and conservation practices each significantly predicts their awareness of terrestrial ecosystem sustainability in Cross River State, Nigeria. Participatory environmental engagement is therefore a meaningful route to building the cognitive foundation of environmental responsibility among young people in this ecologically strategic state.

## **Recommendations**

Based on the findings, the following recommendations are made:

1. Schools in Cross River State should institutionalise regular environmental protection activities clean-up campaigns, tree planting and anti-littering drives to build students' awareness of terrestrial ecosystem sustainability.
2. Conservation practices such as afforestation, school gardens, biodiversity mapping and eco-clubs should be actively promoted and resourced, especially in rural and semi-urban schools where participation is currently limited.
3. Government and NGOs should address the urban–rural disparity in participation by providing materials, trained facilitators and structured programmes to under-served schools.
4. Curriculum planners should integrate hands-on protection and conservation activities into the Social Studies and environmental education curricula rather than relying on classroom instruction alone.
5. Teacher-training institutions should prepare teachers to organise and facilitate participatory environmental activities effectively.

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