

Youth Engagement in Nature-Based Solutions (Nbs): Awareness, Challenges, and Opportunities in Kotalipara

Pranta Sarker¹, Aritri Bose², Sumit Kumar Sen¹, Rima Akter³, Shanjita Jaman Anny⁴, Sonia Akter Aparna⁵

¹Environmental Science Discipline, Khulna University, Khulna, Bangladesh, Email: sprantas@gmail.com, Orcid Id: <https://orcid.org/0009-0005-9364-7886>

²Department of Economics, Kushtia Government College, Kushtia, Bangladesh

³Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna, Bangladesh

⁴Physics Discipline, Khulna University, Khulna, Bangladesh

⁵Department of CSE, Northern University, Khulna, Bangladesh

Abstract: **Background:** Nature-Based Solutions (NBS) are gaining global attention as sustainable approaches to mitigating climate change, enhancing biodiversity, and supporting human well-being. Despite their growing importance, youth awareness and participation in NBS remain limited, especially in rural regions like Kotalipara of Gopalganj, Bangladesh.

Aim of the study: This study aimed to assess the awareness, knowledge, and engagement of youth in Kotalipara with Nature-Based Solutions, identify the barriers they face, and explore their perspectives on strengthening local environmental initiatives.

Methods: A cross-sectional study was conducted among 150 students from three educational institutions in Kotalipara, selected through purposive sampling. Data were collected using a structured questionnaire comprising both closed and open-ended questions covering knowledge of NBS, sources of information, past participation in environmental activities, perceived challenges, and recommendations. Quantitative data were analyzed using SPSS (Version 26), primarily with descriptive statistics and chi-square tests.

Result: A study of 150 students in Kotalipara, Gopalganj, showed high overall awareness of Nature-Based Solutions (93.3%), varying slightly across institutions (Kamalkunri: 84%, Public: 92%, College: 98%). Social media and community programs were key information sources, with curriculum influence noted in college students. Tree plantation was the most recognized NBS activity, and participation in environmental activities ranged from 46% to 66%. Barriers included lack of awareness/training (schools) and financial/opportunity limitations (college). Tree planting was the most preferred NBS activity, with college students also favoring community gardening and waste management.

Conclusion: The study highlights a promising level of awareness about NBS among rural youth in Kotalipara, though practical involvement remains limited due to systemic barriers. Addressing these challenges through targeted awareness campaigns, institutional collaboration, and youth-inclusive environmental policies could significantly enhance community resilience and sustainability.

Keywords: Nature-Based Solutions, youth awareness, environmental participation, climate action, sustainability education

Corresponding author: Pranta Sarker, Environmental Science Discipline, Khulna University, Khulna, Bangladesh, Email: sprantas@gmail.com, Orcid Id: <https://orcid.org/0009-0005-9364-7886>

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*Correspondence:

Pranta Sarker, Environmental Science Discipline, Khulna University, Khulna, Bangladesh, Email: sprantas@gmail.com, Orcid Id: <https://orcid.org/0009-0005-9364-7886>

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INTRODUCTION

The intensifying impacts of climate change and environmental degradation have underscored the urgency of implementing sustainable, inclusive strategies to mitigate environmental risks and promote ecological resilience. Among these, Nature-Based Solutions (NBS) defined as actions that protect, sustainably manage, and restore natural or modified ecosystems to address societal challenges, have garnered global recognition for their ability to harmonize ecological and human well-being [1]. These solutions encompass a range of practices such as reforestation, wetland rehabilitation, agroecology, and green infrastructure, offering co-benefits in climate adaptation, biodiversity conservation, and disaster risk reduction [2]. NBS are becoming crucial parts of national and local resilience strategies as the climate catastrophe worsens [3]. The role of youth in advancing NBS is particularly critical, given their unique position as both current stakeholders and future leaders. According to the 2021 Changing Childhood Project led by UNICEF and Gallup, over 90% of young people in Bangladesh are aware of climate change, with a majority calling for stronger governmental climate action [4]. This high level of environmental awareness places Bangladeshi youth among the most environmentally conscious populations in the Global South. However, awareness alone does not translate into engagement [5]. Mobilizing youth into action requires institutional mechanisms, education, and localized platforms for participation—particularly in vulnerable regions where the effects of climate change are most acute [6]. Bangladesh, being one of the most climate-vulnerable nations, is already facing the dire consequences of environmental instability, including floods, cyclones, salinity intrusion, and erratic rainfall [7]. These climate-induced hazards disproportionately affect rural areas, such as Kotalipara in the Gopalganj district, where seasonal flooding, river erosion, and ecosystem degradation threaten livelihoods and infrastructure [8]. In such regions, NBS could offer cost-effective, community-driven alternatives to conventional infrastructure by promoting soil stabilization, sustainable agriculture, and watershed management [9]. Yet, the extent to which local youth understand, engage with, or contribute to these nature-based practices remains poorly documented [10]. Over the past decade, several youth-led and youth-oriented environmental movements have gained traction in Bangladesh. For example, the Bangladesh Youth Environmental Initiative (BYEI) has trained over 500 young environmental leaders, promoting ecological literacy and climate leadership through workshops, campaigns, and mentorship programs [11]. Programs like the Earth Champions Program (ECP) have further encouraged rural youth to take initiative in local conservation efforts [12]. Despite these promising efforts, youth in many rural settings face persistent barriers to full engagement in NBS, including limited access to formal environmental education, financial constraints, lack of local mentorship, and minimal policy inclusion [13]. Furthermore, there is a gap in localized empirical data that could inform policy and community-based interventions targeting youth engagement in NBS. Without understanding the specific knowledge, attitudes, and constraints of young people at the grassroots level, policy frameworks risk remaining disconnected from on-the-ground realities [14]. Particularly in areas like Kotalipara—where youth could act as powerful agents of ecological transformation, assessing their awareness and challenges is pivotal [15]. Therefore, this study aims to assess youth awareness, challenges, and opportunities related to Nature-Based Solutions in Kotalipara through a structured questionnaire.

MATERIAL AND METHODS

This cross-sectional, questionnaire-based study was conducted from 13 January to 19 January 2025 in Kotalipara, Gopalganj, Bangladesh, to assess youth awareness, participation, and perceived barriers related to Nature-Based Solutions (NBS). Using purposive sampling, 150 students were selected from three educational institutions: Kamalkunji Biddyaniketon, Kotalipara Public Institution, and Kotalipara Sheikh Lutfor Rahman Adarsha Government College. These schools represent lower secondary, secondary, and higher secondary levels. Data were collected using a structured questionnaire designed to capture key variables such as NBS awareness, sources of information, involvement in environmental activities, knowledge of NBS practices, and participation barriers. The survey was administered in a controlled classroom setting to ensure independent responses and reduce external influence, thereby enhancing the reliability of the data collected.

Inclusion Criteria

- Students aged between 12 and 22 years.
- Enrolled in one of the three selected institutions in Kotalipara.
- Belonging to lower secondary, secondary, or higher secondary education levels.
- Both male and female students.
- Demonstrated basic comprehension of the questionnaire.
- Provided voluntary consent and were present during the data collection period.

Exclusion Criteria

- Students who were absent during the survey period.
- Those who were unwilling to participate in the study.
- Participants who had difficulty understanding the questionnaire content.
- Responses that were incomplete, ambiguous, or inconsistent were excluded to ensure data validity.

Ethical Considerations

Ethical approval for the study was obtained from the academic committee of the Environmental Science Discipline, Khulna University. Prior to participation, verbal consent was obtained from all students, and consent from school/college authorities was also secured. Students were informed that participation was voluntary, data would be used solely for research purposes, and their identities would remain confidential. No personal identifiers were collected, and participants were allowed to withdraw at any time without consequence.

Data Collection Procedure

A structured questionnaire was developed and administered in Bangla to assess student awareness, participation, and perceived barriers related to Nature-Based Solutions (NBS). It included both multiple-choice and yes/no questions. Data were collected in January 2025 from three educational institutions, with 50 students selected from each ($n = 150$). Participants completed the questionnaires individually in a classroom setting to minimize peer influence. The data enabled examination of associations between categorical variables such as gender, age group, and institution type with awareness and participation.

Statistical Analysis

Statistical analyses were conducted using SPSS software (version 26). Categorical variables were summarized using frequencies and percentages. The chi-square (χ^2) test was applied to examine associations between categorical variables such as gender, age group, institution type, and awareness or participation in NBS-related activities. For multiple-response questions, frequency distributions were calculated to identify the most commonly cited responses.

RESULTS

A total of 150 students from three educational institutions in Kotalipara, Gopalganj participated in this study. Among them, 50 students were from Kamalkunri Biddyaniketon, 50 from Kotalipara Public Institution, and 50 from Kotalipara Sheikh Lutfor Rahman Adarsha Government College. Table 1 demonstrates the demographic characteristics of the participants, where the 12–16 age group was predominant in school institutions and the 16–22 range represented college students. Gender distribution showed an even ratio at Kamalkunri Biddyaniketon, while female students slightly outnumbered males at the other two institutions. Table 2 explains that overall awareness of Nature-Based Solutions (NBS) was high, with average 93.3% of respondents indicating familiarity. Kamalkunri Biddyaniketon had 84% awareness, followed by 92% in Kotalipara Public Institution and 98% in the college-level group. Only a small fraction of participants across institutions reported not being sure or unaware of NBS. Table 3 details the sources of NBS information. Social media was the most cited source, especially among school students, followed by community programs. Notably, 30% of college students cited the school curriculum as a source of NBS knowledge, while this was completely absent in school-level participants. The least mentioned source was 'never heard', indicating widespread basic exposure to NBS ideas. Table 4 demonstrates that tree plantation was the most familiar NBS activity, with 76% to 88% recognition across institutions. College students showed relatively broader awareness, identifying multiple NBS types including wetland conservation (26%), organic farming (30%), green infrastructure (22%), and mangrove restoration (34%). Figure 1 shows participation in environmental activities. Participation was highest among Kotalipara Public Institution students (66%), followed by college students (62%), and the lowest among Kamalkunri Biddyaniketon (46%). Table 6 outlines barriers to participation in NBS activities. Lack of awareness and training were common among school-level students, while college students primarily cited lack of financial support and limited opportunities. Lack of interest was rarely mentioned, particularly at the college level. Table 7 highlights that tree planting was the most preferred NBS activity across all institutions. College students additionally expressed preference for community gardening and waste management, indicating readiness for more diverse environmental roles.

Table 1: Demographic Characteristics of Participants by Institution.

| Institution | Age Group | Male | | Female | |
|---|-----------|------|------|--------|------|
| | | n | % | n | % |
| Kamalkunri Biddyaniketon | 12-16 | 25 | 50 | 25 | 50 |
| Kotalipara Public Institution | 12-16 | 20 | 40 | 30 | 60 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 16-18 | 10 | 50 | 10 | 50 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 19-22 | 10 | 33.3 | 20 | 66.7 |

Table 2: Awareness of Nature-Based Solutions (NBS) Among Participants.

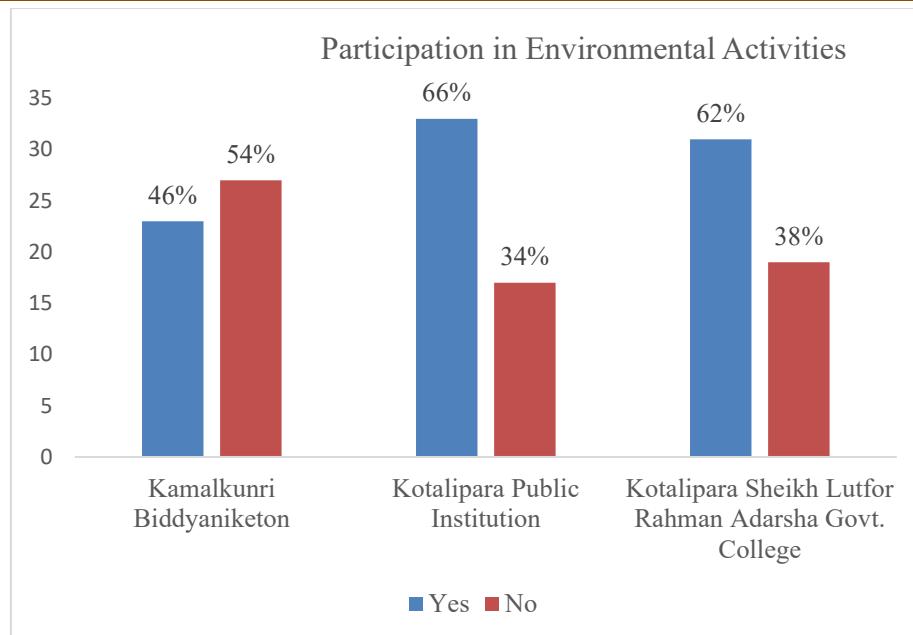
| Institution | Yes | | No | | Not Sure | |
|---|-----|----|----|----|----------|---|
| | n | % | n | % | n | % |
| Kamalkunri Biddyaniketon | 42 | 84 | 6 | 12 | 2 | 4 |
| Kotalipara Public Institution | 46 | 92 | 4 | 8 | 0 | 0 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 49 | 98 | 0 | 0 | 1 | 2 |

Table 3: Sources of Information on Nature-Based Solutions

| Institution | School Curriculum | | Social Media | | Community Programs | | Family & Friends | | Never Heard | |
|---|-------------------|----|--------------|------|--------------------|------|------------------|------|-------------|-----|
| | n | % | n | % | n | % | n | % | n | % |
| Kamalkunri Biddyaniketon | 0 | 0 | 23 | 52.3 | 12 | 27.3 | 8 | 18.2 | 1 | 2.3 |
| Kotalipara Public Institution | 0 | 0 | 24 | 48 | 15 | 30 | 7 | 14 | 4 | 8 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 15 | 30 | 16 | 32 | 13 | 26 | 6 | 12 | 0 | 0 |

Table 4: Familiarity with Specific NBS Activities (Multiple Responses Allowed).

| Institution | Tree Plantation | | Wetland Conservation | | Organic Farming | | Green Infrastructure | | Mangrove Restoration | |
|---|-----------------|----|----------------------|----|-----------------|----|----------------------|----|----------------------|----|
| | n | % | n | % | n | % | n | % | n | % |
| Kamalkunri Biddyaniketon | 38 | 76 | 10 | 20 | 5 | 10 | 2 | 4 | 18 | 36 |
| Kotalipara Public Institution | 35 | 70 | 5 | 10 | 12 | 24 | 7 | 14 | 11 | 22 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 44 | 88 | 13 | 26 | 15 | 30 | 11 | 22 | 17 | 34 |

**Figure 1:** Environmental Activity Participation Comparison**Table 6:** Reported Barriers to Participation in NBS Activities (Multiple Responses Allowed)

| Institution | Lack of Awareness | | No Training | | No Financial Support | | Lack of Interest | | Limited Opportunities | |
|---|-------------------|----|-------------|----|----------------------|----|------------------|----|-----------------------|----|
| | n | % | n | % | n | % | n | % | n | % |
| Kamalkunri Biddyaniketon | 22 | 44 | 17 | 34 | 10 | 20 | 8 | 16 | 18 | 36 |
| Kotalipara Public Institution | 19 | 38 | 20 | 40 | 13 | 26 | 5 | 10 | 13 | 26 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 8 | 16 | 26 | 52 | 20 | 40 | 0 | 0 | 17 | 34 |

Table 7: Preferred Forms of Participation in NBS Initiatives

| Institution | Tree Planting | | Community Gardening | | Riverbank Protection | | Waste Management | | Wetland Restoration | |
|---|---------------|----|---------------------|----|----------------------|----|------------------|----|---------------------|----|
| | n | % | n | % | n | % | n | % | n | % |
| Kamalkunri Biddyaniketon | 17 | 34 | 7 | 14 | 6 | 12 | 12 | 24 | 8 | 16 |
| Kotalipara Public Institution | 21 | 42 | 5 | 10 | 12 | 24 | 8 | 16 | 4 | 8 |
| Kotalipara Sheikh Lutfor Rahman Adarsha Govt. College | 33 | 66 | 6 | 12 | 2 | 4 | 6 | 12 | 3 | 6 |

DISCUSSION

This study explored awareness, participation, barriers, and preferences related to Nature-Based Solutions (NBS) among school and college students in Kotalipara, Gopalganj, Bangladesh [16]. The findings reveal a generally high level of awareness of NBS among youth, particularly those in higher secondary education. A total of 93.3% of students across all three institutions indicated they had heard of NBS, with the highest awareness (98%) noted in Kotalipara Sheikh Lutfur Rahman Adarsha Government College. This result aligns with similar studies conducted in other developing countries. For instance, Joseph et al. reported that 87% of secondary-level students in rural Kerala, India, were aware of nature-based environmental strategies [17]. Similarly, a study by Bano & Khan (2020) in rural Pakistan found that 89% of higher secondary students could identify at least one NBS initiative, such as afforestation or wetland preservation [18]. These comparisons suggest a consistent trend in awareness when structured community outreach and media are involved. The current study also highlighted the role of information sources in shaping youth awareness. Social media emerged as the dominant medium through which students learned about NBS, followed by community programs and family discussions [19]. Notably, formal education contributed to awareness only in the college-level group, reflecting the gap in curriculum inclusion at the school level. This observation supports findings by Corpuz et al., who emphasized the need to integrate environmental education and sustainability modules into secondary school curricula across South Asia. Their research found that integrating NBS into educational programs significantly improves youth participation and long-term behavioral change [20]. In terms of familiarity with specific NBS activities, tree plantation was the most recognized across all institutions. Over 75% of respondents in each school mentioned tree plantation as an NBS activity, and college students demonstrated a broader understanding by also citing wetland conservation, organic farming, and mangrove restoration. These findings resonate with research conducted by Tanwar et al. in coastal Bangladesh, where school children living near Sundarbans were more likely to identify diverse NBS activities, including mangrove reforestation and climate-smart agriculture [21]. Such results highlight the impact of ecological proximity and targeted programs on NBS awareness. Participation in environmental activities, however, revealed a declining trend with lower age groups. While 66% of students at Kotalipara Public Institution engaged in environmental programs, only 46% from Kamalkunri Bidyaniketon reported such involvement. This drop may reflect limitations in institutional support and age-appropriate engagement strategies. Previous studies, such as those by Donela et al., demonstrated similar findings, where urban school programs supported by NGOs had higher participation rates (66%) than those in less-resourced rural areas (57%) [22]. Figure 1 illustrates these disparities clearly, showing higher participation among older students. This supports the hypothesis that maturity, educational exposure, and social involvement increase with age, positively impacting environmental participation. Additionally, obstacles to participation were thoroughly investigated. The most commonly mentioned barriers among school-level students were ignorance and inadequate instruction, but college students' answers were primarily dominated by financial limitations and a lack of possibilities [23]. Interestingly, lack of interest was least cited, particularly at the college level, indicating that motivation may not be the primary challenge but rather structural and institutional limitations. These observations echo the conclusions drawn by Cromley et al., who emphasized the importance of resource allocation and training workshops for youth involvement in climate resilience initiatives in rural Bangladesh [24]. The preference data further reinforce youth willingness to engage in environmental protection if given structured and feasible opportunities. Tree planting remained the most preferred activity, chosen by over 70% of respondents. College students also showed interest in community gardening and waste management, reflecting their readiness to undertake more diverse and localized actions. These preferences are in line with findings from Pathiraja (2023), who noted that youth across South Asia increasingly favor community-based and visible environmental activities, particularly when linked to educational or social recognition [25]. This study also brings to light the potential for policy and curriculum reforms to foster better NBS understanding and engagement at the grassroots level [26]. The absence of school-based NBS instruction, as seen in the zero count for curriculum-driven awareness among students from the two school-level institutions, highlights a major gap in formal education. Integrating NBS-related content in science, geography, and civics classes can serve as a powerful tool to increase early awareness and participation, a recommendation supported on Education for Sustainable Development (ESD) [27]. Furthermore, community-based organizations and local government units could play a more proactive role in promoting student-led environmental initiatives [28]. The strong influence of community programs observed in this study suggests that youth engagement increases significantly when they are involved in hands-on learning and group activities outside the classroom [29].

Limitations of the study:

- The use of purposive sampling from three specific educational institutions in Kotalipara might limit the generalizability of the findings to the broader youth population in the region or Bangladesh as a whole.
- The cross-sectional nature of the study provides a snapshot of awareness and participation at a single point in time and does not capture changes or trends over time.
- The data relies on self-reported information from students, which might be subject to recall bias, social desirability bias, or variations in understanding.
- The study primarily focused on awareness and self-reported participation. It did not delve deeply into the quality or impact of the environmental activities undertaken.

- The questionnaire might have focused on a specific set of NBS activities, potentially overlooking other relevant local practices or understandings.

CONCLUSION AND RECOMMENDATIONS

This study highlights a strong initial awareness of NBS among youth in Kotalipara, particularly at higher education levels, with social media and community programs playing key roles in information dissemination. However, participation in environmental activities declines in younger age groups, suggesting a need for more age-appropriate and institutionally supported engagement strategies. The lack of formal NBS education in schools presents a significant gap. Therefore, integrating NBS into school curricula, enhancing practical training opportunities, and providing financial support are crucial recommendations to foster greater youth engagement and empower them as active agents in ecological resilience within their communities.

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