

Article

An Exploratory Analysis of Knowledge, Attitudes, and Perceptions of Local Community Toward Sustainable Biodiversity Management and Wildlife Conservation in Bangladesh

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Abstract

Local communities residing near protected areas (PAs) play a crucial role in wildlife conservation and biodiversity management, as their knowledge, attitudes, and perceptions (KAP) significantly influence conservation outcomes. However, understanding the socio-ecological relationship between local communities and wildlife remains very limited. This study aims to explore the KAP of local communities toward wildlife conservation and sustainable biodiversity management in Bangladesh. A structured survey was carried out to analyze the local communities' KAP in the selected wildlife areas. The collected data were systematically analyzed using both descriptive and inferential statistical approaches. The result showed that most of the respondents were male (>60%), aged 26–45 years (>65%), with substantial variation in education, including high proportions lacking formal schooling (40–55%). More than half of the respondents earned below BDT 20,000 per month, reflecting economic vulnerability. The results indicated a substantial level of knowledge regarding the ecosystem, human–wildlife conflict, and impacts of illegal hunting and wildlife trade. Attitudes toward conservation were similarly positive including support for wildlife education, reporting poaching, and avoiding harmful practices. In contrast, perception indicators showed a moderate to comparable level of agreement regarding shared conservation, impacts of urbanization, and the need for inclusive governance. The Receiver Operating Characteristic curve analysis demonstrated high predictive accuracy with Area Under the Curve (AUC) for knowledge (AUC = 0.91) and attitudes (AUC = 0.89), and moderate performance for perceptions (AUC = 0.68). The spearman correlation analysis revealed spatially heterogeneous KAP dynamics across wildlife-rich areas. Additionally, the logistic regression analysis revealed that demographic factors, particularly gender and age, were significant predictors of the local community's KAP toward wildlife conservation ($p < 0.05$). The findings urged a comprehensive, integrated conservation strategy that combines community awareness with evidence-based interventions in forest-edge regions. Our study also suggests that a sustainable conservation model is essential for ensuring long-term biodiversity conservation and promoting human–wildlife coexistence in Bangladesh.



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1. Introduction

Global biodiversity and wildlife habitat is declining at an unprecedented rate due to a complex interplay of anthropogenic threats including land-use change, protected area (PA) fragmentation, environmental contamination, climate change, and biological invasions [1,2]. These unusual factors are intensifying, making wildlife conservation a complex social–ecological challenge rather than a purely ecological one [3]. In recent years, human activities have exerted critical pressures on wildlife habitats, making wildlife protection a shared concern for both scientists and the general public [4]. Nowadays, conserving wildlife landscapes has become increasingly complex, posing significant challenges for policymakers and requiring integrated, multidisciplinary conservation strategies [5]. Consequently, conservation knowledge serves as a pivotal driver of social understanding, enhances pro-conservation motivation, and facilitates collective engagement in sustainable biodiversity and wildlife conservation [6,7]. A previous study reported that wildlife conservation largely depends on local communities, who are closely connected to their land, rely on local resources, and have strong knowledge of their environment, including indigenous and traditional groups [8]. Such communities may live in close proximity to intact ecosystems or PAs and engage in activities negatively impacting local biodiversity in developing regions including Bangladesh [9]. Contrarily, many local communities have developed sustainable environmental management practices that support biodiversity and ecosystem resilience [10]. Despite these, a critical gap remains in explaining why substantial levels of knowledge and favorable attitudes do not consistently lead to sustainable conservation practices, particularly in resource-dependent communities. This gap is especially relevant in Bangladesh, where conservation outcomes are shaped by complex interactions between ecological pressures and socio-economic realities.

In Bangladesh, conservation challenges are heightened by high population growth, expansion of human settlements, and increasing pressure on forest resources, leading to significant changes in PA cover and ecosystem integrity [11]. A previous study has documented that the implementation of strict wildlife protection frameworks in rural areas remains constrained by persistent community dependence on natural resources for livelihood sustenance [12]. To effectively incorporate the multifaceted relationship between local communities and biodiversity into conservation efforts, interdisciplinary research is needed to understand the determinants and processes regulating human–nature interactions [13]. In Bangladesh, co-management initiatives have demonstrated potential to improve both PA cover and local livelihoods. However, context-specific evidence remains limited or inaccessible to practitioners in priority conservation areas, therefore constraining the effective implementation of appropriate conservation measures [14]. Our previous study reported that the general public showed moderate to high knowledge and positive perceptions of wildlife conservation, but practical engagement and pro-conservation practices remained comparatively limited [15]. As a result, conservation science could therefore be further strengthened by including more research on local community insight and relationships with wildlife to complement existing evidence in the biological, ecological, and economic dimensions [5,16].

Local community conservation, sometimes called community-oriented or community-based approaches to conservation, are crucial for wildlife habitats and has gained significant importance since the 1980s [17]. As a result, local communities serve a central role as active practitioners of natural resource conservation, sharing their insights and rights with responsibilities for the effective stewardship of wildlife habitats. Previous research indicated that a local community's knowledge and attitudes towards wildlife are often shaped by socio-economic factors, cultural beliefs, and direct interactions with wildlife [18]. Importantly, conservation knowledge serves as a fundamental tool for enhancing people's awareness,

fostering their motivation, and inspiring collaborative efforts toward biodiversity and sustainable resource management [6,7]. It provides individuals with the knowledge necessary to understand the importance of preserving natural ecosystems, thereby promoting collective action and long-term solutions to environmental challenges. Another study reported that despite the Bangladeshi government's efforts to implement wildlife laws and PA policies, the limited integration of local community perspectives and insights remains a significant barrier to conservation success [18]. Enhancing conservation knowledge among local communities is essential for promoting sustainable practices and fostering their active participation in addressing environmental challenges. Recent conservation research increasingly urges the need to account for heterogeneity within peoples, such as variation in socio-demographic characteristics, livelihood dependency, and exposure to human–wildlife conflict. These factors could lead to markedly different conservation attitudes and behaviors [19–22]. Previous studies across South and Southeast Asia have shown that communities with higher dependence on forest resources or greater exposure to wildlife-related risks showed different perceptions toward conservation, despite possessing adequate ecological knowledge [23,24].

Although substantial progress in community-based conservation research has been made, the theoretical and empirical integration of knowledge, attitudes, and perceptions (KAP) outcomes remains incomplete or limited. In particular, the mechanisms underpinning the translation of conservation awareness into actual practices are poorly understood in Bangladesh. Moreover, there is a lack of context-specific, mechanistic understanding of conservation behavior in socio-ecologically complex settings in Bangladesh, where human–wildlife interactions and livelihood dependencies introduce additional layers of variability and uncertainty. Despite these, there remains a limited understanding of how KAP interacts within such heterogeneous socio-ecological contexts, particularly in forest-edge landscapes where human–wildlife interactions are frequent and often conflict-driven. Therefore, the current study underscores the importance of assessing a local community's KAP to identify barriers that hinder the translation of awareness into effective, community-driven conservation action, and that understanding of how local communities view and interact with the wildlife is required.

2. Materials and Methods

2.1. Study Area

The survey was conducted among the four wildlife-rich areas of Bangladesh including Chattogram, Khulna, Mymensingh, and Sylhet (Figure 1). We chose these areas for their high wildlife diversity, varied socio-ecological contexts, and strong dependence of local communities on forest and wildlife resources, which are critical for assessing KAP toward wildlife conservation. Importantly, Chattogram comprises hill forest and coastal ecosystems where indigenous and forest-dependent communities maintain close interactions with wildlife [25]. On the other hand, Khulna includes the Sundarbans mangrove landscape, where local livelihoods are intrinsically linked to forest resources and conservation outcomes are strongly influenced by community participation [26]. Mymensingh represents mixed forest–agricultural mosaics surrounding PAs and semi-PAs, facilitating frequent human–wildlife interactions and community involvement in resource use [25]. Additionally, Sylhet is dominated by evergreen and semi-evergreen forests, including several PAs where long-standing community interactions shape conservation attitudes and practices [18].

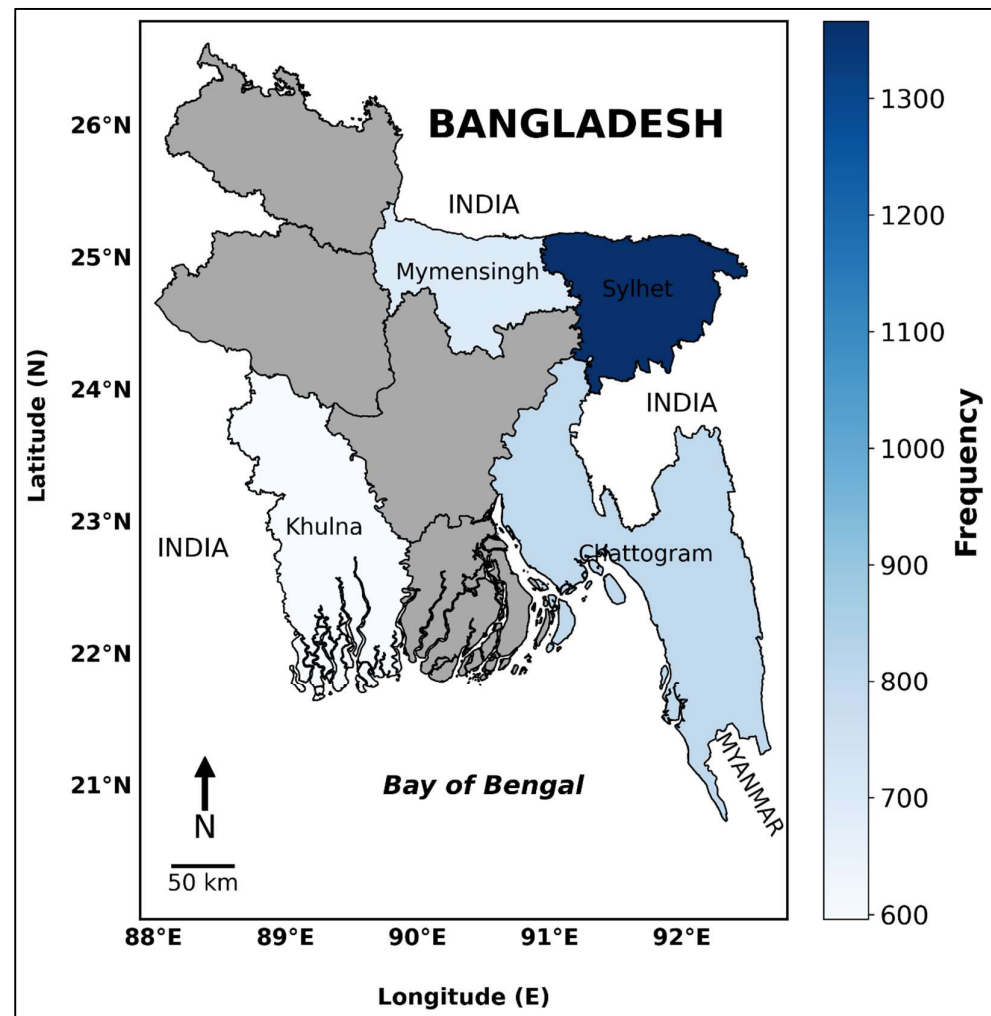


Figure 1. Study area illustrating the frequency of observations across different administrative divisions in Bangladesh. The color gradient represents the frequency of recorded events, with darker blue indicating higher frequency. The map includes geographic coordinates (latitude and longitude), a north arrow for orientation, and a scale bar (50 km) for distance reference.

2.2. Questionnaires Preparation

We prepared a structured-preform questionnaire that comprised sections on demographic information with KAP of wildlife conservation and biodiversity management (Supplementary File S1). The questionnaire employed a five-point Likert scale to measure respondents' KAP toward wildlife conservation, with response options ranging from strongly disagree (1), disagree (2), neutral (3), and agree (4) to strongly agree (5). The questionnaire was administered either in person or online. Prior to participation, respondents were asked to agree to a statement confirming their consent for the collected data to be used for research purposes. Participation in the survey was entirely voluntary and respondents were informed of their right to decline participation or withdraw from the survey at any time without any consequences.

2.3. Study Population and Sampling

The study population consisted of individuals aged > 15 years and residing in forest-edge communities within four selected divisions of Bangladesh. These local communities were considered appropriate for our survey because of their close proximity to PAs and their frequent dependence on forest resources. A multistage cluster sampling design, stratified by division, was used to obtain broad regional representation. Within each

division, villages located adjacent to wildlife areas were identified and selected as primary sampling clusters. After that, the households within each selected village were chosen using systematic sampling based on available household listings. From each selected household, a minimum of one eligible respondent was recruited randomly based on willingness to participate in the survey.

2.4. Data Analysis

After the data collection, all data were compiled in Microsoft Excel and analyzed by following the previous reports with slight modifications [15,27]. For analytical purposes, KAP responses were categorized into binary groups based on predefined criteria, where “strongly disagree” and “disagree” were classified as low (poor), and “neutral,” “agree,” and “strongly agree” were classified as high (good). Each respondent was assigned to the “low” category if at least one response indicated disagreement; otherwise, they were classified as “high”. This binary classification was adopted to facilitate interpretation and comparability with previous KAP studies, although it simplifies the ordinal nature of Likert-scale data. Descriptive statistics, including frequencies and distributions, were calculated to characterize respondent demographics and assess variability in KAP regarding wildlife conservation. Inferential analyses were conducted to explore relationships and predictors of KAP outcomes, including chi-square tests, logistic regression models, and Spearman’s correlation analysis. Demographic variables (e.g., gender, age, education, income, occupation, and division) were included as explanatory factors in the analyses to account for potential sampling bias. To ensure sufficient sample size within categories, rare levels of categorical variables ($n < 20$) were combined into an “Other” category prior to analysis. To address potential class imbalance in the outcome variables, stratified train–test splitting was applied to preserve class proportions between training and testing datasets. In addition, class-weighted logistic regression was used to reduce bias toward the majority class. Logistic regression analyses were conducted primarily to explore associations rather than to develop predictive models. Model performance and classification accuracy were evaluated using receiver operating characteristic (ROC) curves and confusion matrices. Logistic regression results were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). All sorts of statistical analyses and data visualization were performed in Python ver. 3.14.6 using NumPy ver. 2.2.6 [28], Pandas ver. 2.3.1 [29], Matplotlib ver. 3.10.5 [30], and Seaborn ver. 0.13.2 [31]. The geographic representation of the study was generated using Cartopy ver. 0.22 integrated with Matplotlib, utilizing administrative boundary vector data obtained from the Global Administrative Areas (GADM) database ver. 4.1. The statistical significance was determined with a p -value of <0.05 considered statistically significant.

3. Results

3.1. Socio-Demographic Characteristics of the Respondents

The results of the socio-demographic characteristics of respondents demonstrated that a total of 3463 respondents participated in the survey across the four wildlife-rich regions of Bangladesh Sylhet ($n = 1366$), Khulna ($n = 596$), Chattogram ($n = 803$), and Mymensingh ($n = 698$) (Supplementary File S2). Importantly, gender profile varied across regions as female respondents were predominant in Sylhet ($n = 750$, 54.9%) and Khulna ($n = 358$, 60.1%), whereas male respondents constituted the majority in Chattogram ($n = 455$, 56.7%) and Mymensingh ($n = 474$, 67.9%). On the other hand, respondents were largely involved within the economically active age groups (26–45 years) across all regions, as those aged 26–35 years represented 39.9% in Sylhet ($n = 545$), 35.7% in Khulna ($n = 213$), 41.5% in Chattogram ($n = 333$), and 35.8% in Mymensingh ($n = 250$). The age range of

36–45 years accounted for 24.9% in Sylhet ($n = 340$), 23.0% in Khulna ($n = 137$), 21.2% in Chattogram ($n = 170$), and 31.5% in Mymensingh ($n = 220$). The younger respondents aged 15–25 years comprised 16.9–25.8% across all regions, while respondents aged above 55 years represented a small proportion of the sample ($\leq 7\%$ in all regions). Our results showed that the educational qualification of the respondents was generally low, with no institutional education most prevalent in Sylhet ($n = 882$, 64.6%) and Mymensingh ($n = 342$, 49.0%), followed by Chattogram ($n = 289$, 36.0%) and Khulna ($n = 139$, 23.3%). Moreover, up to primary-level education was common in Khulna ($n = 223$, 37.4%) and Mymensingh ($n = 276$, 39.5%), whereas secondary and higher education (SSC and HSC) were relatively more frequent in Chattogram (SSC, $n = 79$, 9.8% and HSC, $n = 105$, 13.1%). Additionally, university education (Honors, Diploma, or Master's degree) was rare across all regions, collectively accounting for $<5\%$ of respondents. The study demonstrated that the monthly income of the majority of respondents was below BDT 20,000 in Sylhet ($n = 1171$, 85.7%), Khulna ($n = 343$, 57.6%), Chattogram ($n = 698$, 86.9%), and Mymensingh ($n = 676$, 96.8%). The results also showed that a considerable proportion of the respondents have no regular income, particularly in Khulna ($n = 244$, 40.9%), while a small portion of the respondent's monthly income exceeded BDT 30,000. Our results demonstrated that the respondents were involved in various occupations with informal and natural resource-based livelihoods. Briefly, in Sylhet, tea garden workers formed the largest occupational group ($n = 658$, 48.2%), whereas, in Khulna, forest and aquatic resource-dependent occupations were prominent, including fishermen ($n = 55$, 9.2%), honey collectors ($n = 25$, 4.2%), and wood collectors ($n = 41$, 6.9%). On the other hand, in Chattogram, farming ($n = 158$, 19.7%) and day labor ($n = 132$, 16.4%) were dominant, while Mymensingh showed a similar pattern with high proportions of farmers ($n = 196$, 28.1%) and day laborers ($n = 194$, 27.8%). Our study also identified additional occupations that included small-scale trading, handicrafts, driving, household work, and informal services indicating livelihood diversity across regions.

3.2. Knowledge on Wildlife Conservation

Our study revealed that responses to knowledge-related items (Q12–Q19) demonstrated substantial comprehension of wildlife conservation principles among study participants (Figure 2). A majority of respondents (78–80%) correctly identified wildlife conservation as encompassing the protection of species and ecosystems (Q12), with strong agreement expressed by an additional 3–4%, whereas neutral responses accounted for 15–17%, while disagreement was minimal ($<3\%$). Similarly, recognition of long-standing human–wildlife coexistence (Q13) was evident among 70–72% of respondents, with $\sim 4\%$ expressing strong agreement; neutral positions represented 8–10% of responses, whereas disagreement was noted in 15–16%. Understanding of human–wildlife conflict drivers (Q14) was affirmed by 72–74% of participants, who recognized population growth and declining wildlife resources as primary contributing factors, supplemented by $\sim 3\%$ strong agreement, whereas neutral and disagreement responses constituted 8–10% and 14–15%, respectively. Importantly, awareness of illegal hunting impacts on wildlife populations (Q15) was acknowledged by 60–62% of respondents, with $\sim 3\%$ strongly agreeing. However, a comparatively elevated proportion (~ 25 – 27%) disagreed, suggesting heterogeneous perceptions regarding enforcement effectiveness and ecological consequences. Recognition that poaching and illegal wildlife trade negatively affect local economies and livelihoods (Q16) was expressed by 62–64% of participants, with 2–3% strongly agreeing. Neutral responses represented 13–15%, while disagreement was observed in 22–24%. The necessity of integrating ecological, legislative, and socio-economic approaches in wildlife conservation (Q17) was recognized by 68–70% of respondents, with $\sim 3\%$ expressing strong agreement, while neutral responses accounted for ~ 19 – 20% , and disagreement remained below 10%.

Notably, support for educational and policy interventions (Q18 and Q19) was particularly robust, with >88–90% of participants affirming that formal education curricula, community advocacy, and dissemination of wildlife protection legislation constitute essential components of effective conservation strategies. Neutral positions were limited to 4–6%, and disagreement was negligible (<3%).

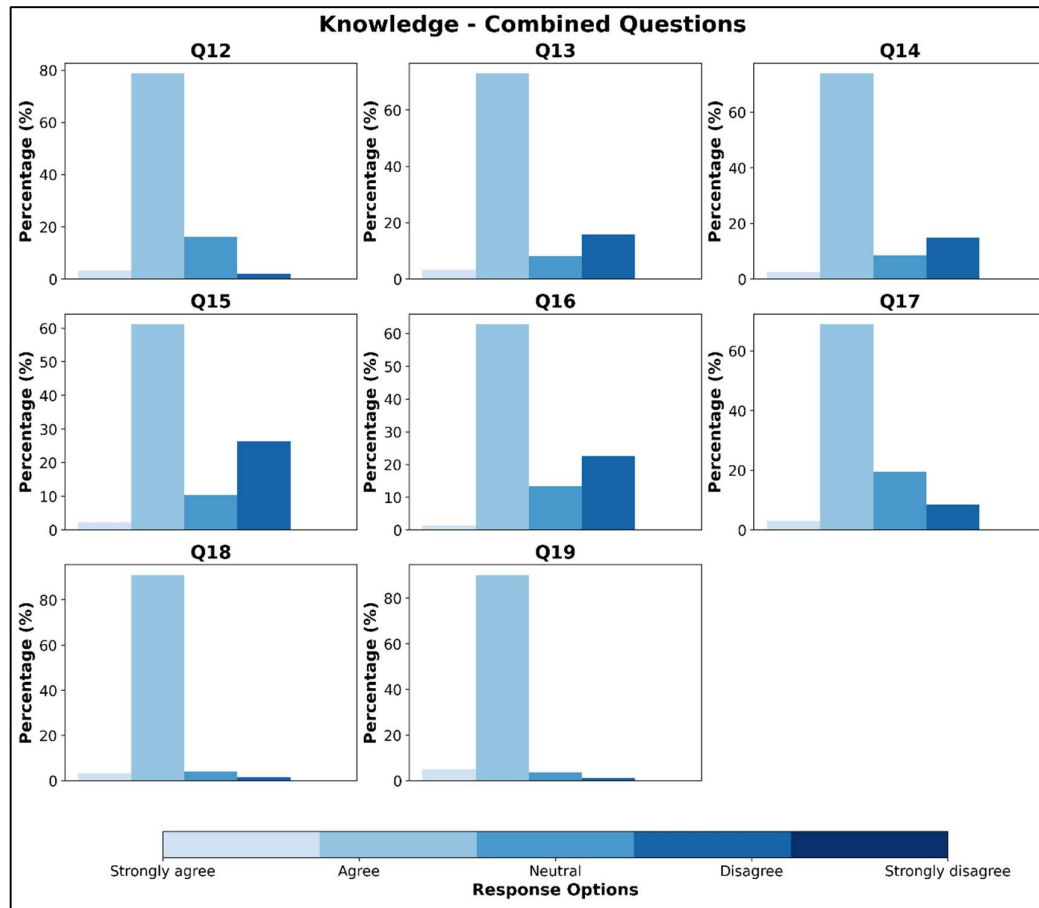


Figure 2. Knowledge-based questions (Q12–Q19) assessing local community understanding and awareness of biodiversity and wildlife conservation issues. Each panel represents the percentage of respondents selecting one of five Likert-scale options (strongly agree, agree, neutral, disagree, strongly disagree) for individual attitude statements.

3.3. Attitudes Toward Wildlife Conservation

Our results showed that responses to the attitude-related questions (Q20–Q27) revealed heterogeneous but generally conservation-supportive attitudes among respondents (Figure 3). For Q20, approximately 62–63% of respondents disagreed with engaging in voluntary activities related to biodiversity conservation, while ~23% agreed, ~12% were neutral, and only ~2–3% strongly agreed, indicating limited willingness to participate in voluntary conservation actions. Similarly, for Q21, a majority (~61–62%) expressed disagreement with actively promoting education and awareness on wildlife management, whereas ~22% agreed, ~15% selected neutral, and <3% strongly agreed. By contrast, attitudes toward wild animal species conservation concern were more favorable. For Q22, about 54–56% of respondents disagreed with conserving threatened wildlife species, while ~27–28% agreed, ~15–16% were neutral, and ~2% strongly agreed, reflecting mixed but polarized attitudes. Concern regarding wildlife killing was comparatively higher. For Q23, nearly 58–60% of respondents agreed that unrestricted killing of wildlife in forests is concerning, while ~27% disagreed, ~13% were neutral, and ~2% strongly agreed. Notably, our result showed

a marked attitudinal pattern for Q24, with a strong majority of respondents (~83–85%) expressing disagreement with engaging in illegal wildlife hunting. In contrast, only ~5–6% reported agreement, ~5–6% remained neutral, and a small proportion (~4–5%) strongly disagreed, collectively indicating widespread opposition to illegal hunting practices within the study population. On the other hand, for Q25, the majority (~78–80%) agreed that they would notify relevant authorities about hunting or poaching incidents, whereas ~11–12% were neutral, ~7–8% disagreed, and ~3% strongly agreed. Moreover, regarding coexistence with wildlife, Q26 showed that ~65–67% of respondents agreed with releasing wildlife back into forests rather than killing animals entering human settlements, while ~20–21% disagreed, ~7–8% were neutral, and ~6–7% strongly agreed. On the other hand, a strong consensus was observed for Q27, where ~88–90% of respondents agreed that authorities should teach wildlife education in educational institutions, whereas neutral responses were limited (~4–5%), and disagreement was minimal (~1–2%).

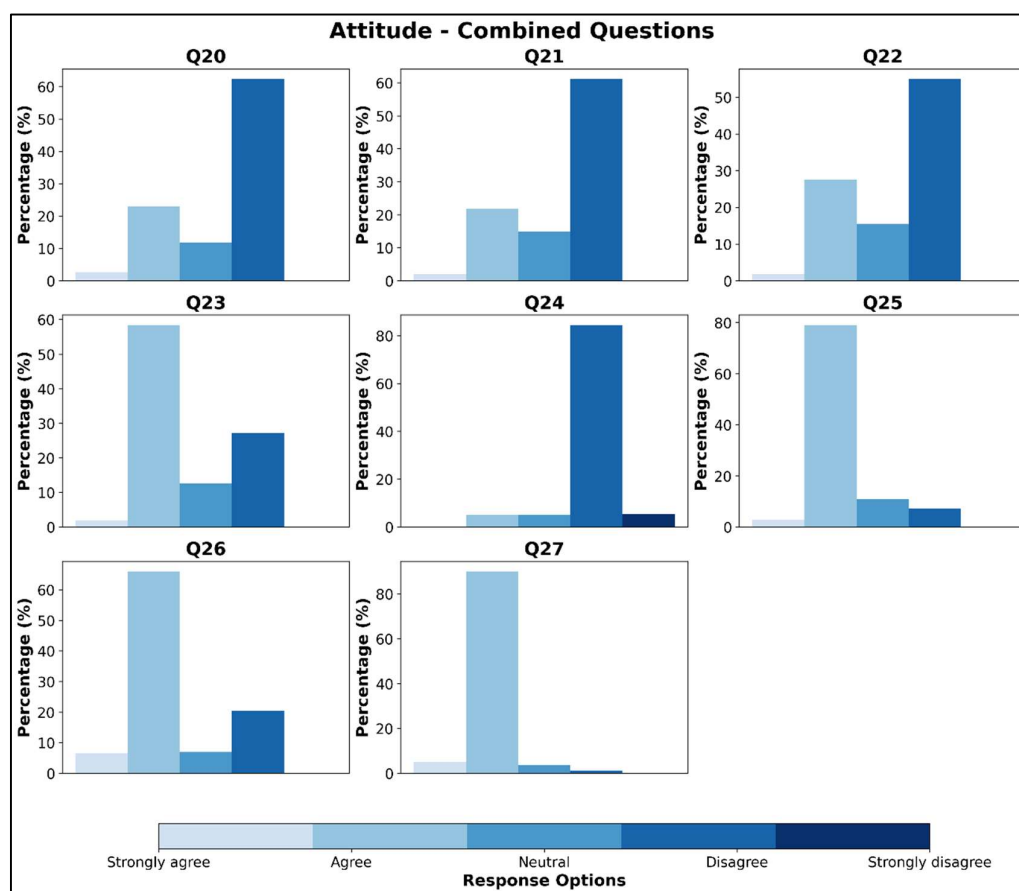


Figure 3. Attitude-based questions (Q20–Q27) of the local community towards wildlife conservation. Each panel represents the percentage of respondents selecting one of five Likert-scale options (strongly agree, agree, neutral, disagree, strongly disagree) for individual attitude statements.

3.4. Perceptions Toward Wildlife Conservation

The current study demonstrated the overall positive perceptions regarding the roles, responsibilities, and ethical dimensions of wildlife conservation in Bangladesh (Figure 4). The responses to the perception-related questions (Q28–Q35) showed diverse but generally conservation-oriented perceptions among the local communities. For Q28, approximately 63–65% of respondents agreed that addressing biodiversity loss and conservation issues should not be assigned solely to the government, while ~15–16% selected neutral responses, ~18–19% disagreed, and ~2% strongly agreed. In Q29, perceptions were highly consistent,

with ~90–92% of respondents agreeing that human well-being is deeply connected to ecosystem welfare, while neutral responses were minimal (~4–5%), and disagreement was negligible (<3%). For Q30, local community responses were more polarized, with 42–44% of respondents agreeing that urbanization and agricultural expansion near wildlife areas should be stopped, whereas ~41–42% disagreed, neutral responses accounted for ~13–14%, and ~2% strongly agreed. In Q31, a majority (~58–60%) agreed that wildlife management and conservation should be science-based rather than guided by personal judgment, whereas neutral responses were reported by ~15–16%, while ~23–24% disagreed and ~2–3% strongly agreed. For Q32, strong consensus was again evident, with ~84–86% of respondents agreeing that local communities contribute to national wildlife conservation initiatives, while neutral responses comprised ~8–9%, disagreement ~4–5%, and strong agreement ~2%. In Q33, approximately 58–60% of respondents agreed that the use of wild animals or their body parts in daily life should be restricted, while ~10–11% were neutral, ~26–27% disagreed, and ~4–5% strongly disagreed. For Q34, about 65–67% of respondents agreed that tribal beliefs and taboos related to hunting negatively affect wildlife conservation; neutral responses were reported by ~15–16%, and disagreement by ~17–18%. Finally, in Q35, a clear majority (~70–72%) agreed that punishments for illegal hunters and wildlife poachers should be more severe, whereas neutral responses accounted for ~4–5%, disagreement for ~15–16%, and ~7–8% strongly agreed.

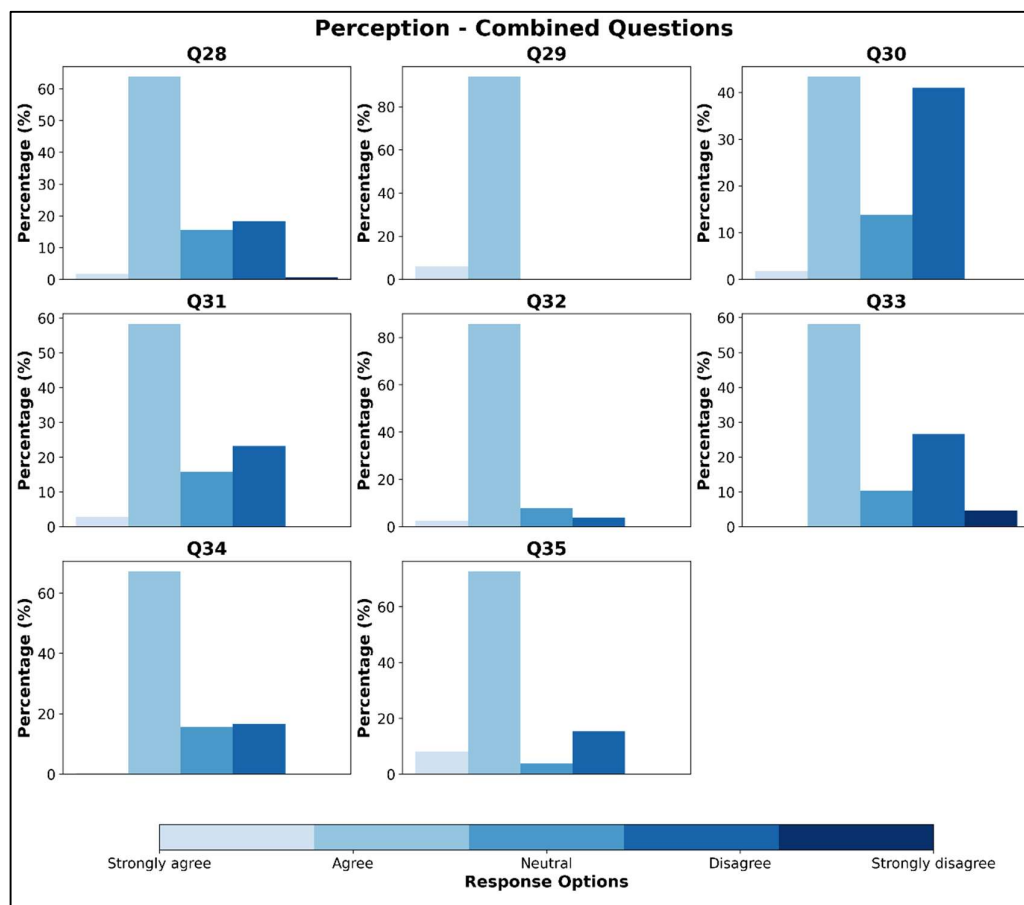


Figure 4. Perception-based questions (Q28–Q35) evaluating local community perceptions towards wildlife conservation. Each panel represents the percentage of respondents selecting one of five Likert-scale options (strongly agree, agree, neutral, disagree, strongly disagree) for individual attitude statements.

3.5. Variation in KAP Toward Wildlife Conservation

The current study demonstrated that significant variation in KAP toward wildlife conservation was observed across all socio-demographic characteristics (Table 1). Gender showed a strong association with KAP outcomes ($p < 0.001$), with a higher proportion of males demonstrating high knowledge (62.4%) compared to females (43.8%). However, positive attitudes were low in both genders, although males (4.2%) showed a slightly higher proportion of good attitudes than females (1.8%). In contrast, females exhibited a higher proportion of good perceptions (25.3%) than males (12.4%). Age was significantly associated with all three KAP domains (knowledge and perceptions: $p < 0.001$; knowledge and attitudes: $p = 0.0013$). The proportion of respondents with high knowledge increased with age, rising from 48.6% in the 15–25-year group to over 83% among those aged ≥ 56 years. Across all age groups, however, good attitudes remained low (1.2–7.1%), whereas good perceptions ranged from 14.3% to 22.0%, with younger respondents exhibiting relatively higher positive perceptions. Educational status showed a strong and consistent association with KAP levels ($p < 0.001$). Respondents with higher education (Honors/Diploma/Degree and Master's level) overwhelmingly demonstrated high knowledge ($\geq 90\%$), whereas those with secondary or no institutional education exhibited substantially lower knowledge levels. Despite these differences, positive attitudes remained limited across all education levels, while good perception ranged from 4.0% to 20.8%, with higher values generally observed among those with formal education. Monthly income was also significantly associated with KAP outcomes (knowledge and perceptions: $p < 0.001$; knowledge and attitudes: $p = 0.0157$). Respondents with no income or higher income brackets ($\geq 21,000$ BDT) showed the highest proportions of high knowledge ($\geq 77.8\%$), while those earning below 10,000 BDT exhibited lower knowledge levels (44.5%). Across all income categories, good attitudes remained rare ($\leq 3.5\%$), whereas good perceptions varied between 10.6% and 26.0%, with the highest proportion observed among respondents with no income. Marked occupational differences were observed in all KAP domains ($p < 0.001$). Respondents engaged in formal occupations (e.g., bankers, government officers, teachers, private jobs, and students) showed very high levels of knowledge ($\geq 85\%$), whereas resource-dependent occupations, including tea garden workers (16.2% high knowledge), day laborers (33.6%), and wood collectors (32.9%), exhibited substantially lower knowledge levels. Across nearly all occupational groups, good attitudes remained below 7%, while good perceptions varied widely, reaching up to 30.7% among housewives. Significant regional variation was also evident across divisions ($p < 0.001$). Respondents from Khulna (86.7%) and Chattogram (81.8%) showed the highest levels of high knowledge, whereas Mymensingh (26.6%) and Sylhet (35.7%) exhibited substantially lower knowledge levels. Positive attitudes were generally low across all divisions but were relatively higher in Chattogram (10.6%). In terms of perception, Khulna (27.3%) and Chattogram (24.2%) demonstrated higher proportions of good perception compared to Sylhet (19.5%) and Mymensingh (3.2%).

Table 1. Variation in respondents' KAP towards wildlife conservation.

Demographics	Description	Knowledge			Attitude			Perception		
		Low	High	<i>p</i> Value	Bad	Good	<i>p</i> Value	Bad	Good	<i>p</i> Value
Gender	Female	944 (56.2)	736 (43.8)	<0.001	1650 (98.2)	30 (1.8)	<0.001	1255 (74.7)	425 (25.3)	<0.001
	Male	671 (37.6)	1112 (62.4)		1709 (95.8)	74 (4.2)		1562 (87.6)	221 (12.4)	
Age	15–25	374 (51.4)	354 (48.6)	<0.001	719 (98.8)	9 (1.2)	0.0013	568 (78.0)	160 (22.0)	<0.001
	26–35	669 (49.9)	672 (50.1)		1303 (97.2)	38 (2.8)		1082 (80.7)	259 (19.3)	
	36–45	431 (49.7)	436 (50.3)		837 (96.5)	30 (3.5)		732 (84.4)	135 (15.6)	
	46–55	111 (31.7)	239 (68.3)		330 (94.3)	20 (5.7)		289 (82.6)	61 (17.4)	
	56–65	23 (17.0)	112 (83.0)		131 (97.0)	4 (3.0)		110 (81.5)	25 (18.5)	
	Above 65	7 (16.7)	35 (83.3)		39 (92.9)	3 (7.1)		36 (85.7)	6 (14.3)	

Table 1. Cont.

Demographics	Description	Knowledge			Attitude			Perception		
		Low	High	p Value	Bad	Good	p Value	Bad	Good	p Value
Education	Master's	19 (9.5)	182 (90.5)	<0.001	195 (97.0)	6 (3.0)	<0.001	167 (83.1)	34 (16.9)	<0.001
	Bachelor's	4 (3.1)	124 (96.9)		127 (99.2)	1 (0.8)		109 (85.2)	19 (14.8)	
	HSC	1 (4.0)	24 (96.0)		23 (92.0)	2 (8.0)		24 (96.0)	1 (4.0)	
	SSC	1162 (70.3)	490 (29.7)		1625 (98.4)	27 (1.6)		1308 (79.2)	344 (20.8)	
	High school	26 (13.6)	165 (86.4)		183 (95.8)	8 (4.2)		165 (86.4)	26 (13.6)	
	Primary school	84 (18.5)	371 (81.5)		428 (94.1)	27 (5.9)		366 (80.4)	89 (19.6)	
	No education	319 (39.3)	492 (60.7)		778 (95.9)	33 (4.1)		678 (83.6)	133 (16.4)	
Income	Below 10,000	921 (55.5)	739 (44.5)	<0.001	1602 (96.5)	58 (3.5)	0.0157	1379 (83.1)	281 (16.9)	<0.001
	11,000–20,000	40 (35.4)	73 (64.6)		109 (96.5)	4 (3.5)		101 (89.4)	12 (10.6)	
	21,000–30,000	2 (22.2)	7 (77.8)		9 (100.0)	0 (0.0)		9 (100.0)	0 (0.0)	
	31,000–40,000	581 (47.3)	647 (52.7)		1188 (96.7)	40 (3.3)		993 (80.9)	235 (19.1)	
	No income	71 (15.7)	382 (84.3)		451 (99.6)	2 (0.4)		335 (74.0)	118 (26.0)	
Occupation	Banker	0 (0.0)	3 (100.0)	<0.001	3 (100.0)	0 (0.0)	<0.001	3 (100.0)	0 (0.0)	<0.001
	Boatman	7 (20.0)	28 (80.0)		35 (100.0)	0 (0.0)		31 (88.6)	4 (11.4)	
	Business	0 (0.0)	9 (100.0)		9 (100.0)	0 (0.0)		9 (100.0)	0 (0.0)	
	Entrepreneur	6 (10.3)	52 (89.7)		54 (93.1)	4 (6.9)		48 (82.8)	10 (17.2)	
	Carpenter	4 (16.7)	20 (83.3)		23 (95.8)	1 (4.2)		22 (91.7)	2 (8.3)	
	Crop harvester	24 (44.4)	30 (55.6)		54 (100.0)	0 (0.0)		52 (96.3)	2 (3.7)	
	Day labor	346 (66.4)	175 (33.6)		489 (93.9)	32 (6.1)		427 (82.0)	94 (18.0)	
	Driver	78 (53.4)	68 (46.6)		140 (95.9)	6 (4.1)		124 (84.9)	22 (15.1)	
	Farmer	197 (42.5)	267 (57.5)		445 (95.9)	19 (4.1)		413 (89.0)	51 (11.0)	
	Fisherman	21 (30.9)	47 (69.1)		68 (100.0)	0 (0.0)		54 (79.4)	14 (20.6)	
	Govt. officer	1 (5.0)	19 (95.0)		20 (100.0)	0 (0.0)		20 (100.0)	0 (0.0)	
	Grocery shop	30 (38.0)	49 (62.0)		78 (98.7)	1 (1.3)		65 (82.3)	14 (17.7)	
	Handicraft	52 (35.4)	95 (64.6)		147 (100.0)	0 (0.0)		119 (81.0)	28 (19.0)	
	Hawker	61 (40.9)	88 (59.1)		148 (99.3)	1 (0.7)		133 (89.3)	16 (10.7)	
	Honey collector	4 (14.3)	24 (85.7)		28 (100.0)	0 (0.0)		26 (92.9)	2 (7.1)	
	Housewife	73 (16.6)	367 (83.4)		414 (94.1)	26 (5.9)		305 (69.3)	135 (30.7)	
	Jhum cultivation	2 (11.1)	16 (88.9)		15 (83.3)	3 (16.7)		18 (100.0)	0 (0.0)	
	Private job	4 (5.8)	65 (94.2)		68 (98.6)	1 (1.4)		55 (79.7)	14 (20.3)	
	Retired	4 (44.4)	5 (55.6)		9 (100.0)	0 (0.0)		8 (88.9)	1 (11.1)	
	Salt labor	6 (75.0)	2 (25.0)		7 (87.5)	1 (12.5)		8 (100.0)	0 (0.0)	
	Social activist	9 (27.3)	24 (72.7)		33 (100.0)	0 (0.0)		30 (90.9)	3 (9.1)	
	Student	20 (10.0)	180 (90.0)		197 (98.5)	3 (1.5)		157 (78.5)	43 (21.5)	
	Tea garden worker	552 (83.8)	107 (16.2)		654 (99.2)	5 (0.8)		498 (75.6)	161 (24.4)	
	Teacher	10 (14.9)	57 (85.1)		66 (98.5)	1 (1.5)		61 (91.0)	6 (9.0)	
	Wood collector	104 (67.1)	51 (32.9)		155 (100.0)	0 (0.0)		131 (84.5)	24 (15.5)	
Division	Chattogram	146 (18.2)	657 (81.8)	<0.001	718 (89.4)	85 (10.6)	<0.001	609 (75.8)	194 (24.2)	<0.001
	Khulna	79 (13.3)	517 (86.7)		594 (99.7)	2 (0.3)		433 (72.7)	163 (27.3)	
	Mymensingh	512 (73.4)	186 (26.6)		698 (100.0)	0 (0.0)		676 (96.8)	22 (3.2)	
	Sylhet	878 (64.3)	488 (35.7)		1349 (98.8)	17 (1.2)		1099 (80.5)	267 (19.5)	

3.6. Confusion Matrix-Based Performance of KAP

The confusion matrix analysis revealed variable classification performance across the KAP components related to wildlife conservation (Figure 5). For knowledge, the model demonstrated relatively balanced predictive performance, correctly classifying 404 respondents with low knowledge and 456 respondents with high knowledge. Misclassification was moderate, with 81 low-knowledge respondents incorrectly predicted as high and 98 high-knowledge respondents misclassified as low. In contrast, the attitude model showed an imbalanced classification pattern, where a substantial number of respondents with low attitudes were correctly identified (857 true negatives), while 151 were misclassified as high. However, among respondents with high attitudes, only 24 were correctly classified, whereas seven were misclassified as low. For perceptions, classification performance was moderate but less robust compared to knowledge. The model correctly classified 458 respondents with low perceptions and 148 respondents with high perceptions. However, a considerable number of misclassifications were observed, with 387 low-perception respondents predicted as high and 46 high-perception respondents predicted as low.

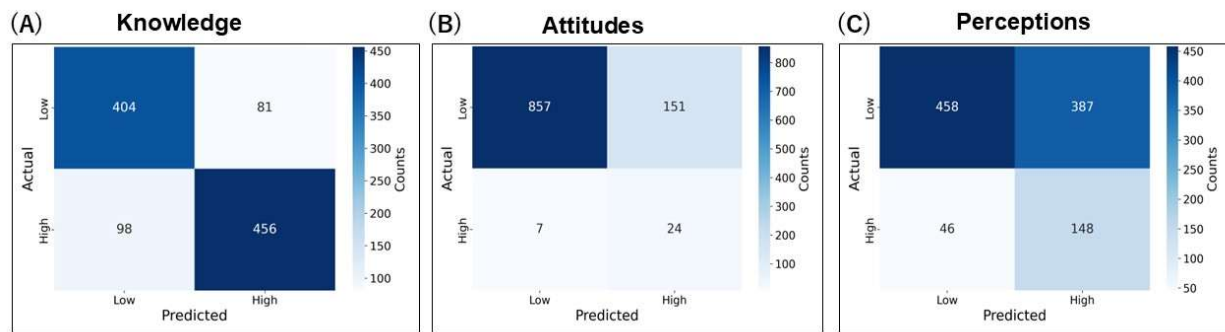


Figure 5. Coefficient plots showing the influence of socio-demographic variables on KAP toward wildlife conservation among local communities. The panels represent standardized regression coefficients for the (A) knowledge, (B) attitude, and (C) perception models. Rows represent the actual class labels, and columns represent the predicted class labels. The diagonal cells indicate correctly classified samples (true positives and true negatives), whereas the off-diagonal cells represent misclassified samples (false positives and false negatives). The color intensity corresponds to the number of observations in each cell.

3.7. Model Performance Evaluation of KAP

The predictive performance of the classification models for KAP toward wildlife conservation was evaluated using ROC curve analysis (Figure 6). Model discrimination was assessed using the area under the curve (AUC), which reflects the ability of each model to distinguish between low and high KAP categories. The knowledge model demonstrated strong discriminative ability, achieving an AUC of 0.90 (Figure 6A). Similarly, the attitude model showed high predictive performance, with an AUC of 0.89 (Figure 6B). By contrast, the perception model demonstrated comparatively lower discriminative capacity, with an AUC of 0.68 (Figure 6C).

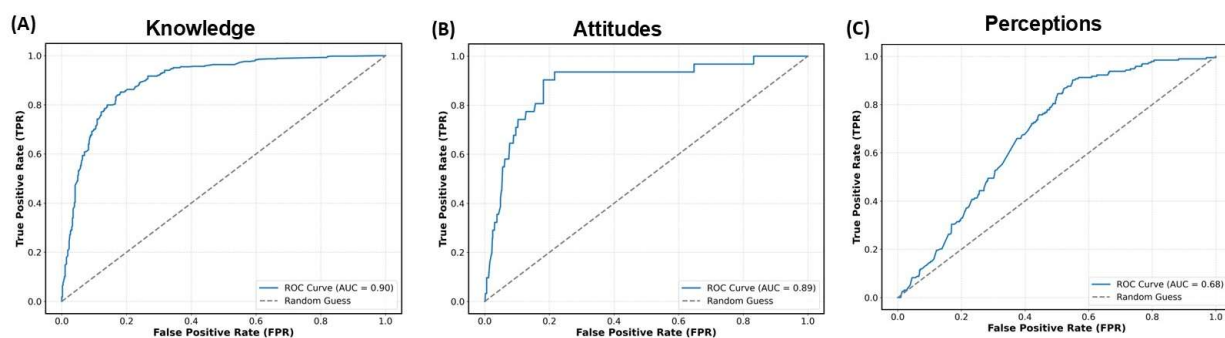


Figure 6. Receiver operating characteristic (ROC) curve analysis of (A) knowledge, (B) attitudes, and (C) perceptions (KAP) towards wildlife conservation. The x-axis represents the false positive rate (FPR), and the y-axis represents the true positive rate (TPR). The diagonal dashed line represents random classification (AUC = 0.5).

3.8. Correlation Analysis of KAP

Spearman's correlation analysis revealed significant but spatially heterogeneous relationships among KAP across the four administrative divisions (Table 2). Knowledge was positively correlated with attitude in all divisions, with moderate correlations observed in Chattogram ($r = 0.444$, $p < 0.001$), Khulna ($r = 0.538$, $p < 0.001$), and Sylhet ($r = 0.510$, $p < 0.001$), whereas the association was comparatively weak in Mymensingh ($r = 0.137$, $p < 0.001$). Knowledge also showed a positive association with perceptions in Chattogram ($r = 0.431$, $p < 0.001$), Khulna ($r = 0.180$, $p < 0.001$), and Mymensingh ($r = 0.243$, $p < 0.001$); by contrast, a weak but significant negative correlation was observed in Sylhet ($r = -0.163$, $p < 0.001$). Attitudes were positively correlated with perceptions in Chattogram ($r = 0.393$,

$p < 0.001$) and Mymensingh ($r = 0.210$, $p < 0.001$), while no significant association was detected in Khulna ($r = 0.048$, $p = 0.243$). In Sylhet, attitudes and perceptions were not correlated ($r = -0.002$, $p = 0.949$), indicating a complete decoupling of attitudinal orientation and perceptual responses in this division.

Table 2. Spearman’s correlation analysis of KAP across four wildlife divisions.

Traits	Chattogram		Khulna		Mymensingh		Sylhet	
	r	p	r	p	r	p	r	p
Knowledge vs. Attitudes	0.444	$3.7 \times 10^{-40} ***$	0.538	$4.3 \times 10^{-46} ***$	0.137	0.0003 ***	0.51	$3.5 \times 10^{-91} ***$
Knowledge vs. Perceptions	0.431	$1.1 \times 10^{-37} ***$	0.18	$9.6 \times 10^{-6} ***$	0.243	$7.5 \times 10^{-11} ***$	−0.163	$1.2 \times 10^{-9} ***$
Attitudes vs. Perceptions	0.393	$5.6 \times 10^{-31} ***$	0.048	0.2434	0.21	$2.1 \times 10^{-8} ***$	−0.002	0.9491

Values represent correlation coefficients (r) with corresponding p-values; asterisk *** indicate statistical significance ($p < 0.001$).

3.9. Logistic Regression Analysis of KAP

The logistic regression analysis demonstrated that several demographic factors significantly influenced the KAP of local communities toward sustainable biodiversity management and wildlife conservation in Bangladesh (Table 3). Gender was a strong determinant, as males were significantly more likely to have adequate knowledge (OR = 2.82, 95% CI: 2.10–3.78, $p < 0.001$) and a positive attitude (OR = 4.50, 95% CI: 1.50–13.52, $p = 0.007$), but showed significantly lower perceptions compared to females (OR = 0.47, 95% CI: 0.35–0.62, $p < 0.001$). Age showed a significant positive association with knowledge, with increasing odds observed across older age groups, particularly among individuals aged 56–65 years (OR = 10.58, $p < 0.001$) and above 65 years (OR = 16.50, $p < 0.001$). Attitudes were significantly higher among respondents aged 36–45 years (OR = 2.82, $p = 0.025$) and 46–55 years (OR = 5.35, $p < 0.001$), while no significant association was found between age and perceptions. Educational status significantly influenced KAP outcomes. Individuals without institutional education had substantially lower knowledge (OR = 0.05, $p < 0.001$), but significantly higher perceptions (OR = 2.07, $p = 0.014$). Respondents with a Master’s level education demonstrated significantly higher positive attitudes (OR = 17.95, $p = 0.011$), whereas other education categories showed no consistent significant associations. Monthly income also played a role in shaping KAP. Respondents with income below 10,000 had significantly higher knowledge (OR = 2.31, $p < 0.001$) and attitudes (OR = 2.05, $p = 0.041$), while those earning 21,000–30,000 had significantly lower knowledge (OR = 0.42, $p = 0.006$). No significant associations were observed between income and perceptions. Occupation did not show statistically significant associations with KAP variables, likely due to variability and wide confidence intervals across occupational groups. Geographical variation was a significant determinant of KAP. Compared to Chattogram, respondents from Mymensingh (OR = 0.09, $p < 0.001$) and Sylhet (OR = 0.22, $p < 0.001$) had significantly lower knowledge levels. Similarly, respondents from Sylhet had significantly lower attitudes (OR = 0.12, $p < 0.001$) and perceptions (OR = 0.53, $p < 0.001$). Khulna also showed significantly lower attitudes (OR = 0.05, $p < 0.001$), although no significant differences were observed in knowledge or perceptions.

Table 3. Logistic regression analysis of KAP towards wildlife conservation.

Categories	Variable	Knowledge				Attitudes				Perceptions			
		<i>p</i> -Value	OR	CI Lower 95%	CI Upper 95%	<i>p</i> -Value	OR	CI Lower 95%	CI Upper 95%	<i>p</i> -Value	OR	CI Lower 95%	CI Upper 95%
Gender	Female	NA	1.00			NA	1.00			NA	1.00		
	Male	<0.001 ***	2.82	2.10	3.78	0.0073 **	4.50	1.50	13.52	<0.001 ***	0.47	0.35	0.62
Age	15–25	NA	1.00			NA	1.00			NA	1.00		
	26–35	<0.001 ***	2.06	1.51	2.79	0.1223	1.98	0.83	4.71	0.2149	0.85	0.66	1.10
	36–45	<0.001 ***	2.35	1.69	3.28	0.0258 *	2.82	1.13	7.01	0.0568	0.75	0.56	1.01
	46–55	<0.001 ***	4.14	2.74	6.26	<0.001 ***	5.35	1.99	14.38	0.7990	1.05	0.71	1.56
	56–65	<0.001 ***	10.58	5.85	19.14	0.1980	2.48	0.62	9.85	0.8134	0.94	0.55	1.61
	Above 65	<0.001 ***	16.50	6.38	42.67	0.0704	4.54	0.88	23.39	0.8956	1.07	0.41	2.77
Education	Master's	0.10	6.71	0.70	64.58	0.0116 *	17.95	1.90	169.28	0.7390	0.69	0.08	6.19
	Bachelor's	0.07	2.87	0.90	9.11	0.2424	0.26	0.03	2.49	0.6351	0.85	0.45	1.64
	HSC	NA	1.00			NA	1.00			NA	1.00		
	SSC	0.33	0.70	0.34	1.44	0.8664	0.90	0.28	2.96	0.8492	0.94	0.52	1.73
	High school	0.0131 *	0.41	0.20	0.83	0.4696	1.47	0.52	4.16	0.0471 *	1.80	1.01	3.20
	Primary school	<0.001 ***	0.17	0.08	0.34	0.2558	1.83	0.64	5.20	0.0421 *	1.84	1.02	3.30
	No education	<0.001 ***	0.05	0.02	0.10	0.7550	0.84	0.28	2.49	0.0142 *	2.07	1.16	3.72
Income	11,000–20,000	NA	1.00			NA	1.00			NA	1.00		
	21,000–30,000	0.0060 **	0.42	0.23	0.78	0.5896	1.44	0.39	5.36	0.6175	0.84	0.43	1.65
	Below 10,000	<0.001 ***	2.31	1.77	3.01	0.0416 *	2.05	1.03	4.10	0.1809	0.84	0.65	1.09
	No income	0.0068 **	2.38	1.27	4.46	0.17	0.29	0.05	1.68	0.1907	0.71	0.43	1.19
	Other	0.05	0.12	0.01	1.04	0.9518	0.00	0.00	>100	0.9344	0.00	0.00	>100
Occupation	Boatman	NA	1.00			NA	1.00			NA	1.00		
	Business	0.93	1.08	0.21	5.42	0.7743	110.91	0.00	>100	0.3023	2.00	0.53	7.52
	Carpenter	0.10	4.38	0.77	24.95	0.6775	932.82	0.00	>100	0.5792	1.70	0.26	10.99
	Crop harvester	0.89	1.11	0.27	4.61	0.9972	0.00	0.00	>100	0.0778	0.19	0.03	1.20
	Day labor	0.22	0.45	0.12	1.63	0.7269	308.54	0.00	>100	0.1564	2.26	0.73	6.95
	Driver	0.37	0.54	0.14	2.08	0.7325	273.41	0.00	>100	0.1374	2.49	0.75	8.32
	Farmer	0.83	0.87	0.24	3.17	0.7659	132.55	0.00	>100	0.5132	1.46	0.47	4.59
	Fisherman	0.11	0.31	0.07	1.28	0.9926	0.00	0.00	>100	0.2736	1.97	0.58	6.66
	Govt. officer	0.40	2.98	0.24	37.09	0.9941	0.00	0.00	>100	0.9201	0.00	0.00	>100
	Grocery shop	0.78	0.82	0.20	3.29	0.7666	131.47	0.00	>100	0.0827	3.03	0.87	10.62
	Handicraft	0.85	1.14	0.30	4.41	0.9943	0.00	0.00	>100	0.8094	1.16	0.35	3.77
	Hawker	0.68	0.75	0.20	2.85	0.8110	51.02	0.00	>100	0.9130	0.93	0.28	3.17
	Honey collector	0.91	0.90	0.13	6.05	0.9855	0.00	0.00	>100	0.4660	0.51	0.09	3.09
	Housewife	0.43	1.75	0.43	7.06	0.6943	635.02	0.00	>100	0.3318	1.79	0.55	5.83
	Private job	0.27	2.62	0.48	14.39	0.7960	70.30	0.00	>100	0.0515	3.67	0.99	13.56
	Social activist	0.59	0.64	0.13	3.16	0.9952	0.00	0.00	>100	0.9390	0.94	0.18	4.93
	Student	0.43	0.54	0.12	2.49	0.7513	182.69	0.00	>100	0.1092	2.88	0.79	10.51
	Tea worker	0.21	0.43	0.12	1.62	0.7526	177.13	0.00	>100	0.2599	1.95	0.61	6.20
	Teacher	0.72	0.75	0.16	3.60	0.7804	98.15	0.00	>100	0.9992	1.00	0.24	4.24
	Wood collector	0.22	0.43	0.12	1.63	0.9891	0.00	0.00	>100	0.1745	2.28	0.69	7.48
	Other	0.58	0.65	0.15	2.92	0.6853	776.32	0.00	>100	0.1304	0.17	0.02	1.68
Division	Chattogram	NA	1.00			NA	1.00			NA	1.00		
	Khulna	0.93	1.02	0.68	1.53	<0.001 ***	0.05	0.01	0.25	0.4788	1.13	0.80	1.60
	Mymensingh	<0.001 ***	0.09	0.07	0.13	0.9865	0.00	0.00	>100	<0.001 ***	0.08	0.05	0.13
	Sylhet	<0.001 ***	0.22	0.16	0.29	<0.001 ***	0.12	0.05	0.26	<0.001 ***	0.53	0.39	0.72

OR: odds ratio; CI: confidence interval; reference categories are indicated. Asterisks indicate statistical significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

4. Discussion

The current study revealed socio-demographic characteristics of respondents that provided important contextual insights into the interpretation of the KAP of local communities toward wildlife conservation and biodiversity management in Bangladesh. Importantly, our study showed a predominance of male and young respondents, indicating underlying socio-cultural dynamics that influence participation in community-based surveys and natural resource-related activities. Previous studies reported that gender imbalance is a well-documented socio-cultural pattern in South Asia, where men dominate public, forest-based, and community decision-making spaces [32,33]. The gender structure has important implications for conservation governance, as exclusion of women from decision-making processes has been shown to weaken long-term sustainability and equity in natural resource management systems [34]. Furthermore, this imbalance may introduce potential sampling bias and limit the generalizability of the findings, particularly with respect to gender-specific perspectives. Therefore, the results should be interpreted with caution, and future studies should aim for more balanced representation across demographic groups.

The younger and economically active age groups are more visible due to their greater involvement in livelihood activities, mobility, and interaction with conservation authorities [35,36]. In contrast, older community members often possess rich traditional ecological knowledge and cultural norms related to wildlife use and taboos, which have been shown to influence conservation outcomes positively or negatively depending on context [37]. The current study showed that the educational qualification of the local community is diversified which may have a significant impact on KAP regarding wildlife conservation. Previous research demonstrated that socio-demographic factors, including a lower education level, reliance on natural resource-based livelihoods, and rural residence, are associated with variability in KAP toward conservation strategies [38]. These results are consistent with the previous study that emphasized the importance of education in fostering environmental consciousness and pro-conservation beliefs [18]. Additional factors, including levels of awareness, value systems, attitudinal orientations, emotional connections to nature, perceived personal responsibility, internal locus of control, and geographical context, have been identified as key determinants influencing biodiversity conservation knowledge [39].

Our research findings indicated the limited spatial variation in conservation knowledge across the four study regions, with no statistically significant differences detected ($p > 0.05$). This result suggested a broadly uniform distribution of knowledge among respondents and is inconsistent with the previous study, indicating that conservation knowledge is strongly influenced by geographical variation [40]. Limited and fragmented knowledge constrains the implementation of community-based approaches, thereby impeding the integrated functioning of socio-ecological systems and contributing to continued PA degradation under persistent environmental challenges [41,42]. Our findings demonstrated that a majority of respondents acknowledged the negative impacts of illegal hunting on wildlife populations, while a considerable proportion of participants expressed disagreement, indicating underlying variability and potential ambivalence in perceptions toward illegal hunting. A previous study has reported that limitations in forest governance, including weak and inconsistent enforcement in PAs, can facilitate the persistence of illegal resource use [43]. In addition, gaps in knowledge of conservation education even among individuals with formal training may further contribute to inadequate prioritization of biodiversity conservation [44]. Other studies reported that local communities may cognitively recognize hunting impacts but contest their severity or legitimacy due to perceived inequities or limited visibility of wildlife declines [36,45]. Although most respondents recognized the negative economic impacts of poaching and illegal wildlife trade, the presence of disagreement and neutrality indicates heterogeneous perceptions, likely driven by differences in livelihood dependence and exposure to wildlife-related activities. This divergence likely reflects the coexistence of short-term livelihood benefits derived from hunting or trade and longer-term costs associated with biodiversity loss, reduced ecosystem services, and foregone ecotourism potential [46]. A substantial proportion of respondents in our study disagreed with participating in voluntary biodiversity conservation activities or promoting wildlife education, indicating a clear KAP-related gap in which awareness and favorable attitudes do not necessarily translate into conservation behavior [47,48].

Previous studies reported that negative attitudes toward wildlife often encourage people to kill wild animals which takes a toll on conservation efforts [49,50]. Despite polarized views on conserving threatened species, the heightened concern over wildlife killing reflects patterns observed in Bangladesh and other developing regions, where moral resistance to killing wildlife endures even in conflict-prone settings [36,51]. Although communities oppose illegal hunting, they are less willing to engage in conservation activities when these involve costs without clear benefits, compensation, or local involvement in India and Nepal [52]. Poaching, hunting, and the illegal wildlife trade all have a detrimental effect on

conservation and knowledge of the negative effects of unsustainable wildlife exploitation is expanding [53]. Our perception-related findings indicated the strong agreement that biodiversity conservation should not be solely the responsibility of the government only, reflecting growing recognition of community-based conservation approaches. Local communities' KAP have shown a pivotal role in mediating the balance between community needs and the long-term sustainability of ecosystems, as they influence how individuals interpret ecosystem benefits, prioritize resource use, and respond to conservation interventions [54,55]. In this context, perception-driven decision-making can either facilitate or hinder the effectiveness of conservation policies. However, the conservation science has been disproportionately dominated by biophysical assessments and economic valuation while the social and cognitive dimensions of ecosystem valuation remain comparatively underexplored [56]. This imbalance is particularly evident in data-deficient regions such as the Hindu Kush Himalaya, where the lack of integrated socio-ecological datasets limits the translation of KAP frameworks into actionable policy and adaptive management strategies [57]. Perceptions of land-use restrictions were highly polarized, reflecting inherent conflicts between conservation objectives and livelihood priorities, consistent with evidence that support declines when economic opportunities are constrained [52].

Our study identified that the majority of the local community's support for restricting the use of wild animals and their body parts indicates increasing awareness of sustainability and legality concerns. Persistent disagreement on this issue highlights the continued influence of cultural practices and subsistence needs, as documented in ethnobiological and wildlife-use studies across Asian countries [51,58]. Social values, which reflect the perceived contributions of ecosystems to human well-being and cultural identity, are critical for shaping behavioral intentions, collective action, and long-term stewardship of PAs [59]. A strong support for stricter punishment of illegal hunters and poachers in the present study indicated public demand for improved enforcement and restricting the weak enforcement that has been identified as a major driver of continued wildlife exploitation [18]. Similarly, a large number of residents living around two PAs expressed favorable attitudes toward conservation initiatives in Nepal [60]. Likewise, farmers in Switzerland valued biodiversity-enhancing practices, particularly the naturalness, aesthetic quality, and structural diversity of conservation-oriented field margins [61]. In contrast, communities living near Chitral Gol National Park in Pakistan showed strong recognition of the park's importance, with 68% reporting positive engagement with park authorities and 97.1% expressing willingness to participate in wildlife management and protection efforts [62]. A comparable scenario was also observed in Europe, such as relatively high levels of public awareness regarding the presence and conservation value of wetland PAs in Greece [63]. Despite these findings, the binary classification method used in this study, where respondents were categorized as "low" if at least one response indicated disagreement may oversimplify complex perception-related responses and contribute to reduced model performance. This limitation may partly explain the weak predictive ability observed in the perception model. Therefore, future studies may benefit from using composite scoring approaches to better capture variability in perception.

Local communities' participation in decision-making is widely recognized as a key mechanism for fostering learning, trust, and stakeholder authority collaboration [64]. This is consistent with the previous study documented in Tanzania, where communities living adjacent to PAs expressed less favorable attitudes toward PA staff than toward conservation objectives themselves [65]. Furthermore, the prioritization of specific ecosystem services often generates trade-offs, particularly under conditions of competing stakeholder interests and limited resource availability, whereas synergies are more likely to emerge through participatory governance and shared decision-making processes [66]. Studies have been car-

ried out on recent community-based conservation efforts in South Asia and Africa, where perceived threats to livelihoods and ecosystem stability are correlated with awareness of illicit wildlife activities [62,67]. Our study report aligns with global evidence demonstrating that environmental education enhances ecological literacy and promotes public participation in wildlife conservation initiatives [68]. Our study showed pro-conservation attitudes among local participants, with strong agreement on the importance of education, awareness raising, voluntary participation, cessation of illegal hunting, and reporting of wildlife violations. These views are consistent with patterns found in other community surveys where conservational behavior is influenced by ethical frameworks and individual obligations [15]. Our study also demonstrated that the respondents showed strong opinions about releasing wildlife instead of killing it when it enters human settlements or the local community. Such views play a critical role in mitigating human–wildlife conflict by supporting conservation outcomes and tolerating retaliatory killings [69]. The respondents emphasized that the government, the local community, and stakeholders who are connected to the wildlife must work together to effectively conserve wildlife biodiversity. This recognition of the inter-link between sustainable ecosystems and human well-being reflects an increasingly prominent socio-ecological perspective in conservation science. Moreover, the local community supports scientific conservation approaches over the conventional process that is necessary for successful wildlife conservation [70]. However, the tribal people's beliefs and myths could have a detrimental impact on conservation outcome strategies, indicating that socio-cultural circumstances continue to be significant determinants influencing attitudes. The current study provides insight into wildlife conservation-related community insights, and their associations with behavioral intentions and community support for it. Our study contributes to sustainable biodiversity management and wildlife conservation in Bangladesh by demonstrating that the local community's KAP serves as a critical socio-ecological determinant of conservation effectiveness.

4.1. Limitations of the Study

While the current study provides valuable insights into local communities' KAP toward wildlife conservation, several limitations should be acknowledged. First, the cross-sectional survey limits causal inference and does not account for temporal variability in conservation awareness or behavior, which may fluctuate due to seasonal, ecological, or policy-related changes. Second, the questionnaire was not formally pre-validated, highlighting the need for future studies to incorporate comprehensive validation procedures. Third, the reliance on self-reported data introduces the potential for social desirability particularly for sensitive issues including illegal hunting, wildlife trade, or non-compliance with conservation regulations. Fourth, despite the use of the survey method and multistage cluster sampling to enhance coverage and representativeness, minor response variations may exist and some hard-to-reach populations such as very remote or socio-economically marginalized groups may be underrepresented. Fifth, although the Likert scale measures are suitable for quantitative analysis, certain complex socio-cultural aspects including traditional ecological knowledge and lived experiences may not be fully represented. Finally, the binary classification method used in this study, where respondents were categorized as "low" if at least one response indicated disagreement, may oversimplify complex KAP response patterns and reduce variability in the outcome variables. This may have contributed to the limited discrimination ability observed in some of the regression models. Future studies may benefit from using composite scoring approaches to better capture the multidimensional nature of KAP responses.

4.2. Implications for Sustainable Conservation

The KAP assessment indicates that effective and sustained wildlife conservation in Bangladesh fundamentally depends on addressing the social, institutional, and livelihood dynamics shaping conservation interventions. Although conservation awareness and general support for wildlife protection were relatively widespread, these did not consistently translate into active conservation behavior, highlighting the influence of local perceptions and economic considerations. In addition, observed variation in KAP across regions indicates that conservation responses are context-dependent and may not be effectively addressed through uniform policy approaches. This study establishes a preliminary foundation for developing community-oriented, evidence-driven, and socially just conservation frameworks for wildlife conservation in Bangladesh. Integrating local community's insights into conservation policy can enhance local ownership, improve compliance, reduce human–wildlife conflict, and support sustainable wildlife management in future.

5. Conclusions

This study provides an integrated quantitative assessment of socio-demographic influences on community-based wildlife conservation awareness in Bangladesh through a KAP framework. Despite socio-economic limitations, respondents demonstrated diverge level of knowledge regarding biodiversity protection, varied attitudes toward wildlife conservation, and moderate but variable perceptions regarding ethical and legislative dimensions of conservation management. The results highlight that variations in wildlife conservation effectiveness are largely driven by underlying socio-demographic and socio-economic conditions. Therefore, consistent conservation-oriented behavior depends on livelihood conditions, local insights, and access to resources. The present findings emphasize that conservation strategies must move beyond awareness-based approaches and instead adopt inclusive, context-specific, and community-driven frameworks. The study also suggests that integrating socio-economic dimensions into conservation policy and developing diverse educational programs could enhance sustainable conservation, mitigate anthropogenic pressures, and promote long-term biodiversity resilience across the country's forest ecosystems.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su18157761/s1>, Supplementary File S1: Survey questionnaire of KAP towards biodiversity management and wildlife conservation; Supplementary File S2: Socio-demographic characteristics of the respondents.

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