

COMMUNITY PERCEPTION OF HUMAN–ELEPHANT CONFLICT AND CONSERVATION ATTITUDES IN THE DONG NAI BIOSPHERE RESERVE, VIETNAM

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Abstract

Human–elephant conflict (HEC) has increasingly become a major challenge for elephant conservation and local livelihoods in regions where humans and elephants coexist. The Dong Nai Biosphere Reserve, which hosts the second-largest remaining elephant population in Vietnam, is no exception. This study assessed the extent of HEC-related damages, examined community awareness, and identified factors influencing local attitudes toward elephant conservation. A structured questionnaire survey was conducted with 430 households across four HEC-prone areas: Thanh Son, Ta Lai, Phu Ly, and Ma Da. Results indicated that 79.5% of respondents had experienced elephant-related damages, predominantly crop losses (69.07%) and threats to psychological well-being and personal safety (39.8%). Additionally, 67.0% believed that HEC has been increasing over time, and 83.3% expressed interest in participating in mitigation measures. A similarly high proportion (83.3%) agreed that elephant conservation is necessary. Logistic regression analysis revealed three variables with statistically significant influence on conservation attitudes: household income ($\text{Exp}(\beta) = 7.910$), interest in HEC mitigation measures ($\text{Exp}(\beta) = 8.295$), and the perception that HEC is increasing ($\text{Exp}(\beta) = 3.254$). These findings underscore the critical role of livelihood security and community awareness in shaping support for elephant conservation. The study recommends strengthening mitigation strategies, improving local livelihoods, enhancing communication and education efforts, and promoting inclusive community participation to reduce conflicts and support sustainable elephant conservation in the Dong Nai Biosphere Reserve.

Keywords: Human–elephant conflict; Community Perception; Conservation Attitudes; Dong Nai Biosphere Reserve; Elephant Conservation.

1. Introduction

Human–elephant conflict (HEC) has become an increasingly significant challenge for elephant conservation and the livelihoods of communities residing near forested landscapes. In many Asian and African countries, HEC occurs in various forms, including crop destruction, property damage, human injuries or fatalities, and retaliatory killings of elephants (Desai & Riddle, 2015; Hoare, 2015). Numerous studies have shown that the extent of damage and the frequency of elephant encounters strongly influence community awareness and attitudes toward conservation, which subsequently shape the success of conflict mitigation initiatives (Barua, Bhagwat, & Jadhav, 2013; Fernando et al., 2005; Krithi K. Karanth, Gopalaswamy, Prasad, & Dasgupta, 2013; Krithi K Karanth & Kudalkar, 2017).

The global Asian elephant (*Elephas maximus*) population is currently estimated at 38,500–52,500 individuals, with national populations ranging from fewer than 100 in Vietnam to more than 25,000 in India. Across most of its range, elephant numbers are declining due to rapid human population growth, habitat loss, degradation, fragmentation, and heightened HEC (Desai & Riddle, 2015; Menon & Tiwari, 2019). Consequently, mitigating habitat loss, reversing fragmentation, and reducing HEC are widely recognized as conservation priorities essential for ensuring the long-term survival of wild elephant populations in both Asia and Africa (Desai & Riddle, 2015; Hoare, 2015; Nguyen, Phan, Ferdin, & Lee, 2021).

Vietnam—part of the native range of the Asian elephant—now holds one of the smallest, most fragmented, and most vulnerable elephant populations in Asia. Historically, the country supported high elephant densities: in the 1970s, approximately 3,000 km² of habitat contained an estimated 1,500–2,000 elephants (Duckworth & Hedges, 1998; Khoi & Tuoc, 1992). However, Vietnam’s wild elephant population has since declined by more than 90%, dropping to just 100–130 individuals by 2020 (Cuong, Giao, Baker, & Kashio, 2002; Dang, Nghia, Dat, & Luong, 2020; Ly, 2011). This dramatic decline is attributable to habitat loss, illegal killing, and intensifying HEC, which now represents one of the most immediate threats to the species’ persistence (Cuong et al., 2002; Dang et al., 2020; Ly, 2011).

Today, surviving elephants in Vietnam are scattered into small, isolated subpopulations, posing severe challenges for conservation management. Recognizing the urgency of the situation, the Vietnamese government—supported by international conservation partners—has implemented a range of measures, establishing 164 protected areas covering over 2.3 million hectares. Elephants were uplisted from “Vulnerable” in 1992 to “Critically Endangered” in 2007, underscoring the critical need for intensified conservation action (Ly, 2011).

To address the threat of extinction, the government approved the “General plan of elephant conservation in Vietnam, period 2013–2020”, later revised in 2022 (Government, 2022). The plan designates several priority conservation sites, including Pu Mat National Park (Nghe An), Yok Don National Park – Ia Lop Forestry Company (Dak Lak), and Cat Tien National Park – Dong Nai Nature and Culture Reserve (Dong Nai). Two additional elephant conservation centers in Quang Nam and Ha Tinh were added in the revised plan. Particularly in Dong Nai province, a VND 74 billion emergency conservation project included the construction of a 50 km electric fence in 2017—mainly around Ma Da and Phu Ly villages—which has significantly reduced elephant incursions (Thuy Linh & Thi Tuyet, 2019; VNFOREST & HSI, 2024). An additional 20 km of fencing is currently being developed in Thanh Son and Ta Lai, aiming to create a 75 km protective barrier in areas with frequent HEC. Local authorities have also provided financial assistance to affected households; however, compensation remains inadequate, leading some residents to adopt drastic measures, including the killing of elephants (Khanh, Mai, & Quoc, 2019; VNFOREST & HSI, 2022).

Community awareness, perceptions of risk, and attitudes toward elephants are widely recognized as critical determinants of successful HEC management and elephant conservation (Borah, Bhattacharya, Sarkar, & Choudhury, 2021; Dickman, 2010; Nsonsi, Heymans, Diamouangana, Mavinga, & Breuer, 2018; Sampson et al., 2019; van de Water & Matteson, 2018). Socio-economic characteristics—including occupation, income, gender, household size, experiences with damage, benefits from

elephant presence, trust in management agencies, and the perceived effectiveness of mitigation strategies—can strongly shape community attitudes (Van Viet, Hong Thi Thu, Thi Thanh Thuy, & Chun-Hung, 2023). For instance, farmers dependent on agriculture tend to be less tolerant of elephants, older individuals often hold more negative views, and households benefiting from ecotourism or conservation programs tend to express more positive attitudes (van de Water & Matteson, 2018). Studies also emphasize that when communities feel excluded from decision-making, inadequately informed, or dissatisfied with mitigation measures (e.g., poorly maintained electric fences), their support for conservation declines markedly (Hoare, 2015).

In the Dong Nai Biosphere Reserve (DNBR), elephants frequently damage local crops (rice, corn, cassava, bananas, sugarcane, cashew), raid food storage areas, and enter homes searching for salt, causing extensive economic losses and safety risks. Several elephants have died due to poisoning, trapping, and shooting in recent decades, contributing to rapid population decline and intensifying conservation challenges (Khanh et al., 2019; Thuy Linh & Thi Tuyet, 2019; VNFOREST & HSI, 2022). Despite the severity of these issues, quantitative research assessing community awareness of HEC and attitudes toward elephant conservation in Vietnam—and in Dong Nai specifically—remains very limited.

Understanding community perceptions of damage, risks, trends in HEC, and the factors influencing conservation attitudes is essential for developing effective, evidence-based, and socially acceptable management strategies.

Therefore, this study aims to:

- (1) assess the extent of HEC-related damage experienced by communities in the Dong Nai Biosphere Reserve;
- (2) analyze community awareness of current HEC patterns;
- (3) examine community attitudes toward elephant conservation; and
- (4) identify factors influencing those attitudes.

The findings provide crucial scientific evidence for policy formulation and offer practical recommendations to reduce conflict while enhancing community participation in wild elephant conservation in Vietnam.

2. Materials and Methods

2.1. Study Area

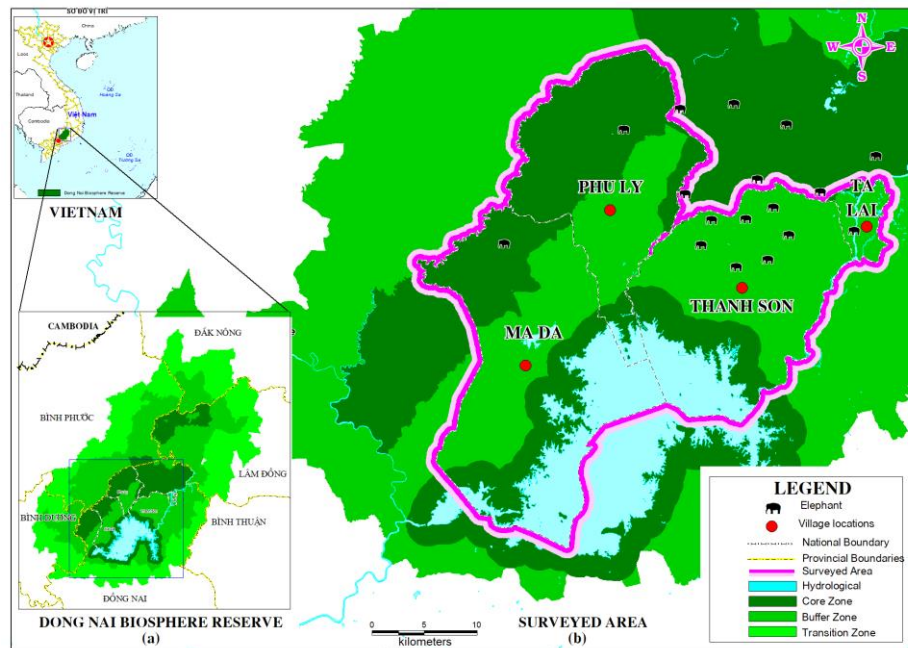
This study was conducted in the DNBR, located in southeastern Vietnam (Figure 1). The reserve encompasses a continuous forest landscape of more than 756,000 hectares and is recognized as one of the country's most intact lowland tropical forest ecosystems. DNBR is well known for its high biodiversity, harboring numerous rare and threatened plant and animal species. Importantly, it supports Vietnam's second-largest remaining population of Asian elephants, estimated at more than 15 individuals (Khanh et al., 2019; VNFOREST & HSI, 2022).

In recent years, DNBR has experienced increasing incidents of HEC, including crop destruction, property damage, and elephant encroachment into residential areas. These incidents occur most frequently in the communes of Thanh Son, Ta Lai, Phu Ly, and Ma Da (Khanh et al., 2019; Thuy Linh & Thi Tuyet, 2019; VNFOREST & HSI, 2022). These areas are characterized by a mosaic of agricultural land and forest edges, high farming intensity, and close

proximity to elephant foraging and movement routes—conditions that contribute to frequent interactions between local people and elephants.

Given the ecological importance of DNBR and the growing severity of HEC, assessing community awareness and attitudes toward elephant conservation in this region is essential for developing effective conflict mitigation and long-term conservation strategies.

Figure 1. Study area



(Source: (Van Viet et al., 2023))

2.2. Data Collection

The sample size was first determined using Cochran’s (1977) (Cochran, 1977) formula for sociological research:

$$n = \frac{z^2 pq}{e^2} \quad (1)$$

with a 95% confidence level and an allowable error of less than 5%. The calculation indicated a minimum sample size of approximately 385 respondents. To increase the reliability and robustness of subsequent statistical analyses, particularly regression modeling, the study surveyed 440 individuals, exceeding the required minimum.

Data were collected through direct, face-to-face interviews with households located in areas experiencing frequent HEC incidents. Four communes with documented high levels of elephant activity—Thanh Son, Phu Ly, Ma Da, and Ta Lai (Thuy Linh & Thi Tuyet, 2019)—were selected for the survey. A systematic random sampling technique was employed to ensure representative participation across villages.

A structured questionnaire was developed comprising four sections. Section 1 gathered socio-demographic information, including gender, marital status, occupation, age, education, and income. Section 2 focused on respondents’ perceptions of the extent and types of damage caused by HEC. Section 3 captured

community awareness and perceptions of current HEC conditions. Section 4 assessed attitudes and views regarding elephant conservation. Ethical considerations were strictly observed throughout data collection. Verbal informed consent was obtained from all participants, who were assured of their right to withdraw at any time or skip any question. Personal information was kept confidential and used solely for research purposes. Of the 440 individuals invited, 430 completed the questionnaire, yielding a response rate of 97.7%. The respondents represented households from four HEC-prone areas within the DNBR. Of these, 57.2% were male and 42.8% female, and the majority were married (91.9%). Most respondents were farmers (78.8%), reflecting the predominantly agriculture-based livelihoods of buffer zone communities. The largest age group was 40–49 years (30.0%), followed by those aged 30–39 (24.7%), indicating that the sample largely comprised individuals in their productive working years with substantial agricultural experience. Educational attainment was moderate, with 53.0% completing high school, 22.6% receiving vocational training, and 18.1% holding college or university degrees; only 6.3% had less than a high school education. Household income levels were generally low, with 58.4% earning 2–4 million VND per month and only 3.5% reporting monthly incomes above 8 million VND

2.3. Data Processing and Analysis

All collected data were cleaned, coded, and entered into Microsoft Excel 2010 and subsequently exported to IBM SPSS Statistics 26.0 for analysis. Microsoft Excel was used to summarize socio-demographic characteristics, describe the extent of HEC-related damage, and assess awareness and support for mitigation measures. Perception variables (e.g., “HEC is increasing,” “interested in mitigation measures”) were coded as binary (Yes = 1; No = 0). Attitudes toward elephant conservation served as the dependent variable in the regression analysis.

To identify factors influencing community attitudes toward elephant conservation, a Binary Logistic Regression model was applied using SPSS 26.0. The model is expressed as:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_kX_k \quad (2)$$

where:

P is the probability that a respondent holds a positive conservation attitude (coded 1 = “conservation is necessary”; 0 = “not necessary”).

X_i represents independent variables, including:

Interest in HEC mitigation measures (1 = Yes; 0 = No);

Perception that HEC has been increasing (1 = Yes; 0 = No);

Household income (ordinal variable).

The $\text{Exp}(\beta)$ values were used to interpret the effect size of each independent variable on the likelihood of supporting elephant conservation.

Model evaluation employed several goodness-of-fit diagnostics, including the Chi-square test for overall model significance, the Hosmer–Lemeshow test for calibration, pseudo R^2 statistics (Cox & Snell, Nagelkerke), and classification accuracy to assess predictive performance.

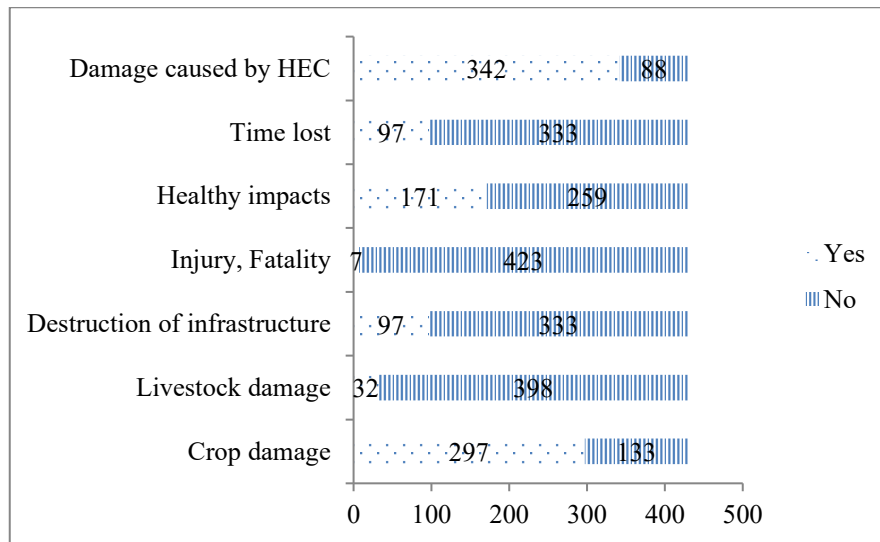
3. Results

3.1. Damage caused by human–elephant conflict

As shown in Figure 2, 79.5% of respondents (n = 342) reported experiencing damage caused by elephants. Crop damage was the most frequently reported type of damage, affecting 69.1% of respondents (n = 297). Healthy impacts—specifically concerns about personal safety and anxiety due to frequent elephant presence—were also substantial, reported by 39.8% of respondents (n = 171).

In addition, 22.6% of respondents (n = 97) experienced damage to infrastructure such as trails, water pumps, and livestock barns, or incurred additional time and labor costs for guarding fields, repairing damaged property, or avoiding elephant encounters. A smaller proportion (7.4%) reported livestock losses, and 1.6% reported human injuries or fatalities associated with elephant incidents.

Figure 2. Damage caused by human–elephant conflict

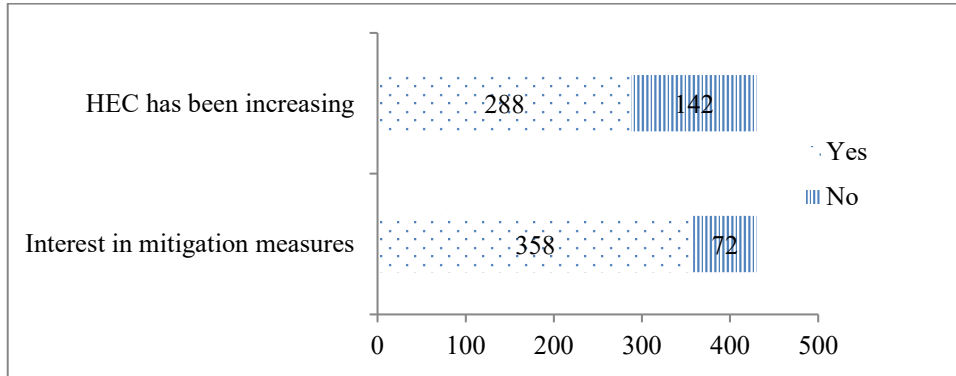


3.2. Community perceptions of human–elephant conflict

As shown in Figure 3, community perceptions indicate that a majority of respondents (67.0%, n = 288) believe that HEC has increased in recent years, while 33.0% (n = 142) disagreed. A substantial proportion of respondents (83.3%, n = 358) expressed interest in HEC mitigation measures, including electric fences, early warning systems, rapid response teams, and compensation schemes. This high level of interest suggests strong community willingness to engage in mitigation efforts when effective support systems are available.

However, several respondents reported skepticism regarding the effectiveness of existing measures. Their concerns stem from incidents where elephants have crossed electric fences, inconsistent installation or maintenance of warning signs, and continued crop and property damage despite ongoing interventions. These findings highlight the need for improved and more reliable mitigation strategies to build trust and enhance community participation.

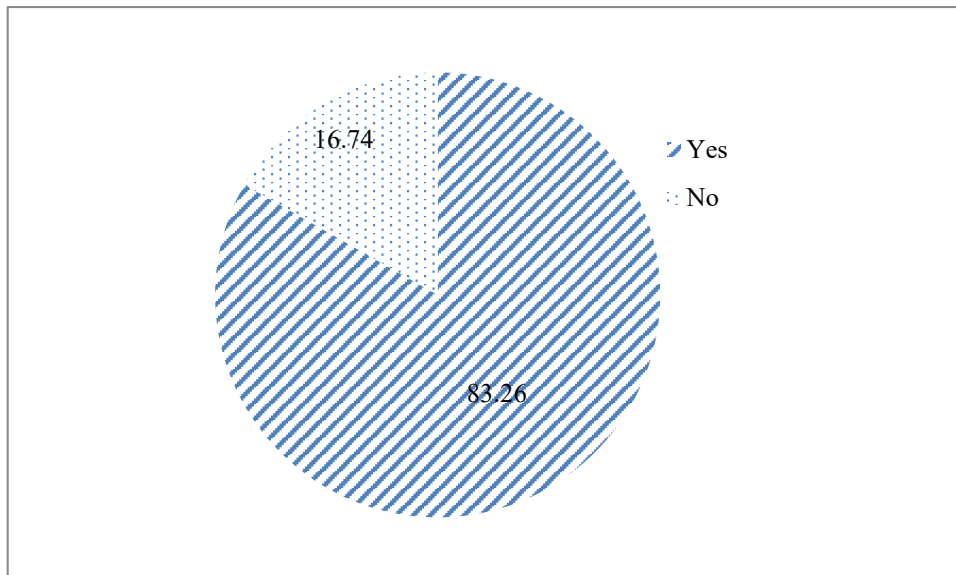
Figure 3. Community perceptions of human–elephant conflict



3.3. Community attitudes toward elephant conservation

Community attitudes toward elephant conservation were assessed by asking respondents whether they believed that elephants should be conserved in the area. As shown in Figure 4, the majority of respondents expressed positive views toward conservation: 83.3% (n = 358) agreed that elephants should be protected. This high level of support reflects a generally favorable attitude toward conservation efforts despite the challenges posed by human–elephant conflict.

Figure 4. Community attitudes toward elephant conservation



3.4. Factors influencing community attitudes towards elephant conservation

The results of the binary logistic regression model (Table 1) show that three variables significantly influenced community attitudes toward elephant conservation: interest in mitigation measures, perception that HEC is increasing,

and household income.

Among these, interest in mitigation measures exhibited the strongest effect, with $\beta = 2.116$ and $\text{Exp}(\beta) = 8.295$. This indicates that households expressing interest in mitigation interventions were approximately 8.3 times more likely to support elephant conservation than those who were not interested. Household income was the second most influential factor ($\beta = 2.068$; $\text{Exp}(\beta) = 7.910$), suggesting that higher-income households were nearly eight times more likely to support conservation compared with lower-income households. In addition, respondents who perceived that HEC is increasing were 3.25 times more likely to support elephant conservation than those who did not share this perception ($\beta = 1.180$; $\text{Exp}(\beta) = 3.254$).

The regression model demonstrated strong statistical significance ($\chi^2 = 101.377$, $df = 3$, $p < 0.001$). The Hosmer–Lemeshow goodness-of-fit test indicated adequate model fit, as no significant difference was observed between predicted and actual values ($p > 0.05$). While the Cox & Snell R^2 value was modest, the Nagelkerke R^2 value (35.3%) indicates that the model explains a substantial proportion of the variance in conservation attitudes. The model’s predictive performance was also high, with a classification accuracy of 83.3%.

Table 1. Factors influencing community attitudes towards elephant conservation

Factors	β	$\text{Exp}(\beta)$	p-value
Interest in mitigation measures (1= “Yes”; 0 = “No”)	2.116	8.295	0.000
HEC has been increasing (1= “Yes”; 0 = “No”)	1.180	3.254	0.000
Income	2.068	7.910	0.000
Constant	-3.085	0.046	0.000
-2LL	$(\chi^2 = 101.377, df = 3, p < 0.001)$		287.177
Cox & Snell R Square			21.0%
Nagelkerke R^2			35.3%
Hosmer & Lemeshow test			$p = 0.074$
Classification accuracy			83.3%

4. Discussion

The findings of this study demonstrate that HEC in the DNBR is widespread and multifaceted, consistent with patterns documented across Asia and Africa. Among households surveyed, 79.5% reported experiencing elephant-related damage, with crop losses (69.1%) and concerns about health and personal safety (39.8%) being the most common impacts. For example, one respondent described that “*despite the lights being fully on, elephants still entered individual households and pulled out maize to eat,*” illustrating the severity and persistence of HEC incidents. These results indicate a high level of human–elephant interaction in communes such as Thanh Son, Ta Lai, Phu Ly, and Ma Da. Comparable levels of crop damage have

been reported in India or Congo, where more than 70% of farming households living adjacent to forests are affected by elephants (Borah et al., 2021; Nsonsi et al., 2018), as well as in Myanmar, Sri Lanka, and Thailand (Fernando et al., 2005; Sampson et al., 2019; Thant, May, & Røskaft, 2023; van de Water & Matteson, 2018).

The perception that HEC has increased in recent years (reported by 67.0% of respondents) reflects broader regional trends. One respondent noted that “*in the past, elephants would retreat when chased away, whereas now they often turn back and attack people,*” highlighting a perceived escalation in both the frequency and severity of HEC. Habitat loss, agricultural expansion, and forest fragmentation have consistently been identified as major drivers of rising HEC incidents in Asia (Chen et al., 2016; Desai & Riddle, 2015). This is also consistent with evidence from India, where 91% of residents believe HEC is escalating due to land-use pressures and livelihood needs (Nsonsi et al., 2017). In Dong Nai, shrinking elephant movement corridors and diminished natural forage force elephants to move closer to residential areas, where they are attracted to highly palatable crops such as rice, bananas, cassava, and sugarcane (Khanh et al., 2019; Thuy Linh & Thi Tuyet, 2019; VNFOREST & HSI, 2022).

To address escalating HEC, Dong Nai Province implemented the *Emergency Project for Elephant Conservation* during 2014–2020. This initiative included rapid assessments of elephant population size, identification of key elephant food plant species, community awareness and education programs for residents in elephant-prone areas, and the implementation of multiple conflict mitigation measures. A central component of the project was the construction of electric fencing, with a planned total length of 75 km to prevent and reduce HEC. The first phase, comprising 50 km of electric fencing, was completed in 2017. Since 2020, with support from Humane Society International (HSI), Dong Nai has piloted three additional initiatives: camera-trap-based elephant monitoring, systematic HEC monitoring, and habitat management for elephants. These initiatives have improved understanding of elephant population size, social structure, and individual health, as well as the spatial distribution, intensity, types, and drivers of HEC. Such evidence has provided an important foundation for local authorities to design subsequent conservation and conflict mitigation strategies. In parallel, the province has continued to expand electric fencing infrastructure, completing an additional 22 km to further reduce HEC. In addition, extensive outreach and education programs have been implemented to raise community awareness of elephant conservation and promote effective practices for preventing HECs (HSI, 2023; VNFOREST & HSI, 2024).

Encouragingly, a large proportion of respondents (83.3%) expressed interest in HEC mitigation measures—such as electric fencing, early warning systems, rapid response teams, and compensation schemes—indicating strong community willingness to participate in conflict management. Similar patterns have been observed in Myanmar (Sampson et al., 2019), where community engagement increases when mitigation approaches are effective, transparent, and socioeconomically appropriate.

The logistic regression results identify three key factors shaping community attitudes toward elephant conservation: interest in mitigation measures, household income, and the perception that HEC is increasing. These findings align with prior research on the socio-ecological drivers of conservation attitudes.

First, interest in mitigation measures was the strongest predictor of conservation

support ($\text{Exp}(\beta) = 8.295$). This underscores the centrality of community participation in wildlife management, a principle widely recognized in conservation theory and practice (Sampson et al., 2019; van de Water & Matteson, 2018). When mitigation strategies such as electric fences and compensation programs are perceived as credible and effective, communities are more likely to cooperate with conservation efforts. Similar results from Assam, India, show that confidence in mitigation interventions is the strongest determinant of conservation attitudes (Borah et al., 2021).

Second, household income had a significant positive effect on conservation attitudes ($\text{Exp}(\beta) = 7.910$). This finding supports the poverty–wildlife conflict nexus, which suggests that poorer households—being more vulnerable to risk—tend to adopt more negative views toward wildlife. Studies in Thailand and China similarly demonstrate that low-income households are disproportionately affected by wildlife damage and exhibit lower support for conservation (van de Water & Matteson, 2018; Wang, Cai, Hu, Cirella, & Xie, 2020).

Third, the perception that HEC is increasing was positively associated with conservation support. Although heightened conflict often correlates with negative attitudes, some studies show that awareness of escalating threats can motivate people to support long-term conservation interventions (Borah et al., 2021; Nsonsi et al., 2018). In Dong Nai, individuals who recognized the trend of rising conflict may better understand the urgency of managing elephant populations and securing habitats.

Overall, the findings highlight that HEC mitigation is not solely a technical issue but is strongly shaped by socio-economic conditions, awareness, and community involvement. When households have stable livelihoods, feel included in management processes, and perceive mitigation strategies as effective, they are more inclined to support elephant conservation and less likely to engage in retaliatory behaviors. These insights emphasize the need for integrated approaches that combine technical solutions with participatory governance, livelihood improvement, and long-term habitat management.

5. Conclusions

This study provides important empirical evidence on the extent of damage caused by HEC, community awareness, and attitudes toward elephant conservation in the DNBR—one of Vietnam’s most critical regions for wild elephant protection. The findings confirm that HEC is frequent and diverse in nature, with crop losses being the most widespread impact. A majority of respondents perceive that HEC is increasing and express strong interest in mitigation measures, reflecting substantial concern among local communities.

The logistic regression analysis identified three key factors influencing community support for elephant conservation: (i) household income, (ii) interest in mitigation measures, and (iii) perception that HEC is increasing. These results highlight the need to integrate livelihood improvement, community engagement, and effective mitigation strategies to enhance public support for elephant conservation initiatives.

Overall, the study underscores that communities play a vital role in sustainable HEC management. Technical interventions alone—such as electric fences or warning

systems—will be insufficient without complementary policies that improve local livelihoods, expand communication and education, and strengthen community participation. A holistic and community-centered approach is therefore essential for achieving long-term coexistence between humans and elephants in the DNBR.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT in order to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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