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Research Article

# Anti-Poaching for Endangered Megafauna Conservation in Assam, India: Examining Stakeholder Perception

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## Abstract

India is the stronghold for endangered species and poaching and illegal trade have seriously threatened wildlife conservation. Against this backdrop, Indian regulatory authorities have strengthened workforce capacity for monitoring and enforcement actions against poaching, employed patrolling systems, and adopted lethal deterrence-based policies. However, efforts to control poaching and conserve biodiversity are often at odds with local communities' needs and interests, and stakeholder participation in management is integral to successful wildlife conservation. This research aims to understand stakeholder perception of anti-poaching management practices and tribal customs in protected areas. A survey was conducted to gather information from forest staff and fringe villagers at the four national parks and one wildlife sanctuary in Assam, India. The results indicate that villagers around protected areas generally perceive that the Forest Department and patrolling effectively prevent poaching. However, stakeholders' perceptions of the lethal deterrence-based policies and tribal customs were split, depending on the local communities' unique social, economic, and political situations. Leveraging these responses, wildlife managers in India can collaborate with villagers around the protected areas to address the threats of poaching to wild megafauna. Further, this research underpins the reason to strengthen the enforcement capacity of forest staff, as they stand at the frontline of endangered species protection in biodiversity-rich, developing countries.

## Keywords

Poaching, Anti-poaching Management Practices, Tribal Customs, National Parks, Protected Areas, Stakeholder Perception

## 1. Introduction

The evolution of conservation policy in post-colonial India can be divided into three phases [35]. From 1947 to 1970, the first phase focused on forest conservation policy, ignoring wildlife. During the second phase, from 1971 to 1990, India started to develop a wildlife-related policy, initiating Project Tiger and a network of protected areas. These protected areas help conserve biodiversity and natural resources through national wildlife action plans [55]. The third and last phase occurred from 1990 to the present, in which wildlife poaching, habitat loss, and human and wildlife conflict have been explored [35].

Stakeholder participation in management is integral to successful wildlife conservation [1, 35]. However, efforts to conserve biodiversity are often at odds with the needs and interests of human activities [37-49]. In recent decades, wildlife poaching has surged in India, and India has become a hotspot for poaching with around 27% of globally trafficked tigers for the past twenty years [53]. To counteract this surge,

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the Indian Forest Department has enacted anti-poaching management practices within protected areas. For example, they constructed anti-poaching camps in which the forest staff was stationed within the protected areas, patrolled protected areas, and initiated deterrence policies, including killing poachers on site. These anti-poaching management practices often impact and involve forest-dependent communities near the protected areas [3].

Wildlife management requires complex trade-offs by various stakeholders [50], and meeting diverse stakeholder's interests was understood as important for natural resource management in India [51]. Stakeholder engagement in the decision-making process can avoid the pitfalls of poor governance. Furthermore, knowledge of stakeholder interests and the likely effects of decision alternatives on all types of stakeholders is known to be critical as elements for successful wildlife conservation by eliciting public trust for uncertain wildlife management decisions [1, 7, 41].

At present, there needs to be a more understanding of stakeholder engagement regarding anti-poaching management practices in India. Most of the studies conducted relate to stakeholder's understanding of India's wildlife protection policies, but forest villagers' perceptions have not been examined [27, 41, 43]. Also, prior scholars have paid attention to ecotourism as a solution to wildlife poaching, rather than anti-poaching management practices undertaken by regulatory authorities in protected areas [6, 8]. In expanding this line of research, this research thus aims to understand forest management staff and forest villagers' perceptions regarding anti-poaching management practices in local communities where wildlife-human conflicts are severe.

## 2. Background

*Drivers of Poaching*

The primary driver of wildlife poaching is market demand, especially dealing with greater one-horned rhino (Rhinoceros unicornis), Bengal tigers (Panthera tigris tigris), and Asian elephants (Elephas maximus) [53]. It is estimated that rhino horns could range from $97,000 USD per kg to $400,000 USD per kg [5, 19], while a dead tiger is worth $50,000 to $70,000 USD on the black market [22]. Unlike the African elephant (Loxodonta Africana), the Asian elephant is mostly poached for its skin, and elephant skin is worth $120 USD per kilogram [17].

Assam in India has been vulnerable to wildlife poaching since the proximity of Assam being near a porous international/state border with Myanmar and Nagaland has led to some opportunistic wildlife poaching [52]. Oftentimes, these poachers sell poached wildlife on the black market for illegal firearms [52]. The lucrative sales of rhino horns, tiger derivatives, and elephant skin on the black market incentivize wildlife poaching, especially in Assam [53]. More importantly, wildlife poaching exceeds the biological capacities of wild species and causes a broader crisis in biodiversity loss [48].

The management of protected areas in India is the responsibility of the state Office of Principle Chief Conservator of Forest (PCCF) and Head of Forest Force (HoFF). The state PCCF & HoFF is legally authorized under the Wildlife Protection Act (1972) to manage all activities and initiatives in the protected areas. Specific management practices, such as anti-poaching efforts, are then determined by the Field Directors (FDs), Division Field Officers (DFOs), and Conservators of Forest (CFs) of each protected area. For example, FDs, DFOs, and CFs determine the number of forest staff stationed in each protected area, the average kilometer patrolled by forest staff, and the execution of deterrence policies by forest staff. Despite the significance of anti-poaching management practices in wildlife conservation, less is known about stakeholder perception on those conservation policy tools. To fill this research void, a novel survey was conducted to investigate to what extent forest villagers and forest staff support the Forest Department at preventing poaching, patrolling protected areas, and killing poachers on site as a precautionary approach, and lastly, whether tribal customs could prevent poaching. In doing so, this research presents the first kind of empirical results, while providing an in-depth understanding of the perceived efficacy of anti-poaching management practices.

## 3. Methods

### 3.1. Study Sites

Assam, India is a biodiversity hotspot with rich floral and faunal variety. It has an elaborate network of protected areas [3]. Among the protected areas, this research focused on the five study sites. They are Manas National Park, Kaziranga National Park, Orang National Park, Nameri National Park, and East Karbi Anglong Wildlife Sanctuary. Of these National Parks, there are also four Tiger Reserves, Manas, Kaziranga, Orang, and Nameri Tiger Reserves. These Tiger Reserves were constituted by the National Tiger Conservation Authority, and the Assam Forest Department is highly visible in them. The National Parks and Tiger Reserves oftentimes overlap in their areas. Manas and Kaziranga National Parks are UNESCO World Heritage Sites. Manas National Park is a Biosphere Reserve, a biodiversity hotspot due to avian fauna. East Karbi Anglong Wildlife Sanctuary protects a great variety of wildlife but it is a critical habitat for elephant protection. Table 1 summarizes the five study sites in Assam, India [18].

***Table 1.*** *Five Study Sites, Assam in India.*

| Protected Area | Special Designations | Size (sq. km) | Endangered Megafauna |
|---|---|---|---|
| East Karbi Anglong Wildlife Sanctuary | Autonomous Zone[1] | 221 | Elephant |
| Kaziranga National Park/Tiger Reserve | UNESCO World Heritage Site | 430 | Tiger, elephant, rhino |
| Manas National Park/ Tiger Reserve | UNESCO World Heritage Site / Biosphere Reserve | 500 | Tiger, elephant, rhino |
| Nameri National Park/Tiger Reserve | | 200 | Tiger, elephant |
| Rajiv Gandhi Orang National Park/Tiger Reserve | | 78.80 | Tiger, elephant, rhino |

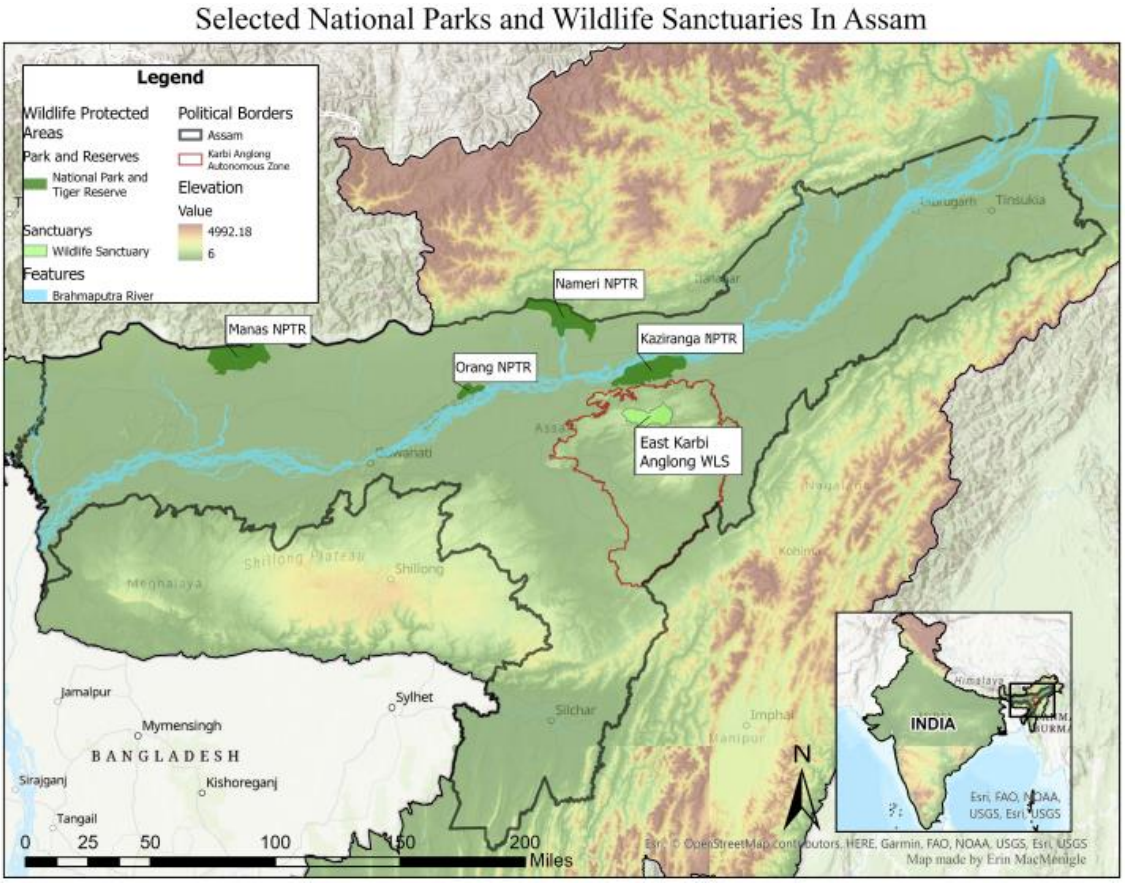


***Figure 1.*** *Selected National Parks and Wildlife Sanctuaries in Assam.*

## 3.2. Data Collection and Analysis

To understand stakeholder perceptions regarding anti-poaching mechanisms, a survey was conducted in April to August 2021 by simple random sampling. The survey protocol was approved by George Mason University's Institutional Review Board (#1386794-2), and a series of questions regarding anti-poaching management practices and tribal customs were asked in Assamese (local dialect) via translator. The answers were recorded using the five-point Likert-type scale, where '1' represents "strongly disagree" and '5' represents "strongly agree," and answers were translated and recorded into English. Fringe villages comprised of less than 50 people, and forest staff stationed in the protected areas were invited to the survey, a total of 202 surveys were collected sampling. Three to six fringe villages were sampled per protected area. For the data analysis, a series of non-parametric statistical methods was used as the survey outcomes were coded with the five-point Likert scale [23, 45]. The Dunn test, a non-parametric pairwise multiple comparison procedure, was used to identify which group's responses demonstrated statistical difference from each other [11]. To reduce a Type 1 error when performing multiple tests,

Holm's-alpha correction for the Dunn test was used [20]. Tables were generated in R using R packages ggplot2 [46, 56] and GGstatsplot [44] for data visualization.

## 4. Results

*(1) The Forest Department is effective at preventing poaching.*

The survey first asked how villagers and forest department staff perceive the effectiveness of forest department at preventing poaching. Table 2 showed all participants except Karbi Anglong agreed with the statement that the forest department was effective at preventing poaching. Likewise, Table 3 showed a strong statistical difference ($p < 0.001$) from the responses of Karbi Anglong to all other participants responses.

***Table 2.*** *Descriptive Summary.*

| Groups | Number of Participants | Median | Interquartile Range |
|---|---|---|---|
| Forest Staff | 43 | 5 (Strongly Agreed) | 1.0 |
| Karbi Anglong | 30 | 2 (Disagreed) | 1.0 |
| Kaziranga | 32 | 5 (Strongly Agreed) | 1.0 |
| Manas | 34 | 5 (Strongly Agreed) | 3.25 |
| Nameri | 32 | 4 (Agreed) | 1.0 |
| Organg | 31 | 5 (Strongly Agreed) | 0.5 |

***Table 3.*** *Dunn Test.*

| | Forest Staff | Karbi Anglong | Kaziranga | Manas | Nameri |
|---|---|---|---|---|---|
| Karbi Anglong | -4.881*** | | | | |
| Kaziranga | -0.022 | 4.549*** | | | |
| Manas | -0.552 | 4.130*** | -0.494 | | |
| Nameri | -0.636 | 3.985*** | -0.574 | -0.089 | |
| Orang | 0.774 | 5.245*** | -0.743 | 1.244 | 1.312 |

Note: $^{*}$=p<0.05, $^{**}$=p<0.01, $^{***}$=p<0.001

(2) *Patrolling is an effective tool at preventing poaching.*

As the second question, survey participants were asked if patrolling is an effective tool at preventing poaching. Table 4 showed all participants, with the exception of Karbi Anglong, strongly agreed or agreed with the statement that patrolling was an effective tool at preventing poaching. Table 5 showed a strong statistical difference ($p < 0.001$) in responses between Karbi Anglong to participants in the forest staff, Kaziranga, Manas, and Nameri, while there is a statical difference ($p<0.01$) in responses to participants in Orang. That means, forest department staff believed that patrolling is effective in managing poaching, but forest villagers around Karbi Anglong indicated their neutral stance toward the efficacy of patrolling. Also, while villagers around Orang agreed the effectiveness of patrolling but their support level was lower than that of forest staff.

***Table 4.*** *Descriptive Summary.*

| Groups | Number of Participants | Median | Interquartile Range |
|---|---|---|---|
| Forest Staff | 43 | 5 (Strongly Agreed) | 0.5 |
| Karbi Anglong | 30 | 3 (Neither Agreed nor Disagreed) | 2.0 |

| Groups | Number of Participants | Median | Interquartile Range |
|---|---|---|---|
| Kaziranga | 32 | 5 (Strongly Agreed) | 1.0 |
| Manas | 34 | 5 (Strongly Agreed) | 1.0 |
| Nameri | 32 | 4 (Agreed) | 1.0 |
| Orang | 31 | 4 (Agreed) | 0.5 |

***Table 5.*** *Dunn Test.*

| | Forest Staff | Karbi Anglong | Kaziranga | Manas | Nameri |
|---|---|---|---|---|---|
| Karbi Anglong | -5.465*** | | | | |
| Kaziranga | -0.143 | 4.985*** | | | |
| Manas | -1.337 | 3.965*** | -1.111 | | |
| Nameri | -2.079 | 3.206*** | -1.808 | -0.725 | |
| Orang | -3.492** | 1.64 | -3.133* | -2.077 | -1.338 |

Note: *=p< 0.05, **=p<0.01, ***=p<0.001

*(3) Killing poachers is an effective tool at preventing poaching.*

The third question asked survey participants to indicate if killing poachers was an effective tool for preventing poaching. Table 6 showed mixed responses among participants regarding killing poachers. Forest villagers around Kaziranga and Nameri Parks indicated that lethal deterrence policy approach is effective, while forest staff and villagers around Karbi Anglong and Manas Parks disagreed. Table 7 showed a strong statistical difference ($p < 0.001$) in responses between Kaziranga and Manas, forest Staff, and Karbi Anglong. A statistical difference ($p<0.01$) in responses between Kaziranga and Nameri. Lastly, a statistical difference ($p < 0.05$) in responses between Orang and Forest Staff, Karbi Anglong, and Manas.

***Table 6.*** *Descriptive Summary.*

| Groups | Number of Participants | Median | Interquartile Range |
|---|---|---|---|
| Forest Staff | 43 | 2 (Disagreed) | 2.5 |
| Karbi Anglong | 30 | 2 (Disagreed) | 0.0 |
| Kaziranga | 32 | 5 (Strongly Agreed) | 1.25 |
| Manas | 34 | 1 (Strongly Disagreed) | 4.0 |
| Nameri | 32 | 2 (Disagreed) | 1.25 |
| Organg | 31 | 5 (Strongly Agreed) | 3.0 |

***Table 7.*** *Dunn Test.*

| Groups | Forest Staff | Karbi Anglong | Kaziranga | Manas | Nameri |
|---|---|---|---|---|---|
| Karbi Anglong | -0.327 | | | | |
| Kaziranga | 5.234*** | 5.114*** | | | |

| Groups | Forest Staff | Karbi Anglong | Kaziranga | Manas | Nameri |
|---|---|---|---|---|---|
| Manas | -0.414 | -0.069 | -5.346*** | | |
| Nameri | 1.203 | 1.411 | -3.764** | 1.526 | |
| Orang | 2.726* | 2.811* | -2.300 | 2.969* | 1.434 |

Note: *=p<0.05, **=p<0.01, ***=p<0.001

*(4) There are tribal customs that prevent poaching.*

As the last question, survey participants were asked if villagers or forest staff believe that tribal customs can help poaching to be prevented. Table 8 showed mixed responses regarding this question. Table 9 showed a strong statistical difference ($p < 0.001$) in responses between Manas and Forest Staff, Karbi Anglong, and Kaziranga. As such, villagers around Manas Park do not believe that triable customs are instrumental in preventing poaching. Likewise, a strong statistical difference in responses ($p < 0.001$) between Manas and Orang.

***Table 8.*** *Descriptive Summary.*

| Groups | Number of Participants | Median | Interquartile Range |
|---|---|---|---|
| Forest Staff | 43 | 3 (Neither Agreed nor Disagreed) | 4.0 |
| Karbi Anglong | 30 | 4 (Agreed) | 2.5 |
| Kaziranga | 32 | 4 (Agreed) | 2.25 |
| Manas | 34 | 1 (Strongly Disagreed) | 0.0 |
| Nameri | 32 | 2 (Disagreed) | 1.0 |
| Orang | 31 | 3 (Neither Agreed nor Disagreed) | 3.0 |

***Table 9.*** *Dunn Test.*

| | Forest Staff | Karbi Anglong | Kaziranga | Manas | Nameri |
|---|---|---|---|---|---|
| Karbi Anglong | 2.155 | | | | |
| Kaziranga | 2.121 | -0.069 | | | |
| Manas | -4.660*** | -6.316*** | -6.352*** | | |
| Nameri | -1.991 | -3.846** | -3.840** | 2.455 | |
| Orang | 0.232 | -1.788 | -1.748 | 4.526*** | 2.061 |

Note: *=p<0.05, **=p<0.01, ***=p<0.001

## 5. Discussion

Assam is a biodiversity hotspot for endangered megafauna like wild tigers, rhinos, and elephants [4, 18]. Currently, wildlife poaching is threatening these endangered species [53], and regulated authorities in governments have adopted and implemented anti-poaching management practices. They include but are not limited to strengthening monitoring and enforcement in protected areas, using patrolling systems, and adopting deterrence-based policies. However, there is no scholarly attention to the anti-poaching management practices, and no attempt has been made to empirically understand how stakeholders perceive the efficacy of anti-poaching management practices. This study fills this research void.

Forest staff are a vital part of wildlife management because they provide wildlife protection and security, interface with local communities, and monitor wildlife populations and

habitats [57, 58]. According to World Wildlife Fund for Nature (2018), the Indian subcontinent has approximately 60,000 field staff-- more than any country in South Asia. The average forest staff salary is $259.24 USD per month. The average workday is 76.2 hours (about 3 days) per week including 27.5 hours per week between the hours of 6pm and 6am [57]. More importantly, forest staff are stationed in anti-poaching camps around the perimeter of the protected area, routinely patrol the protected area day/night, and execute deterrence policies [3].

The Forest Department enforces anti-poaching management practices in each protected area. A notable exception is East Karbi Anglong Wildlife Sanctuary in which the forest staff are neither stationed, nor patrol the protected area. Under the Constitution of India, Karbi Anglong is considered an autonomous administrative division. Currently, there are ten autonomous councils in Assam, Meghalaya, Mizoran, and Tripura. These autonomous councils have legislative, executive, and judicial powers. The powers and presence of the Forest Department are greatly diminished in these autonomous zones, and the relationship between these autonomous councils and the Forest Department can be tenuous [33]. However, there is a representative of the Forest Department in Karbi Anglong that works with the autonomous council regarding conservation efforts of the protected area.

In the survey, the statement 'I think Forest Department is effective at preventing poaching.' There was a large, statistically significant difference in stakeholders' perceptions about this statement. Villagers in Manas, Nameri, Orang, Kaziranga, and Forest Staff, in general, agreed that the Forest Department is effective. While villagers near East Karbi Anglong had a median response that showed significantly less agreement than other groups. A possible explanation might be related to East Karbi Anglong located in the autonomous district of Karbi Anglong, and its relationship with the Forest Department. Therefore, it is understandable that villagers near protected areas with strong forest staff presence may have greater confidence in the Forest Department in preventing poaching than protected areas with diminished forest staff presence.

Patrolling is another indicator of the Forest Department presence in protected areas. Patrolling plays an important role in preventing wildlife poaching and it can identify hotspots for poaching in which enforcement efforts can be focused [21, 38]. In Assam, patrolling is exclusively conducted by the forest staff, and they are equipped with firearms, communication devices (e.g., walkie-talkies), navigation tools (e.g., compass), and uniforms with boots [15]. Forest staff take firearms and communication devices on their daily patrol. Most of the patrolling in Assam is done on foot and in pairs of forest staff [57]. However, there is jeep, elephant, and boat patrolling as well.

As to the survey question of patrolling as an effective tool for poaching prevention, it found similar results to the rating of effectiveness of the Forest Department. The survey showed a large, significant difference in perception regarding this statement. Villagers near East Karbi Anglong didn't agree with the Forest Staff as well as villagers near Kaziranga, Nameri, and Manas National Parks. Villagers near Orang National Park showed significantly less agreement than Forest Staff and villagers near Kaziranga National Park. A possible explanation might be that forested communities oftentimes associate the Forest Department with patrolling activities and East Karbi Anglong and Orang have diminished the presence of the Forest Department than other protected areas. For example, East Karbi Anglong has no forest staff patrolling due to its location in an autonomous zone, and Orang has less forest staff patrolling than other National Parks/Tiger Reserves due to its small park size (78.89 sq.km). Therefore, it is understandable that villagers around these protected areas would not think that patrolling was an important anti-poaching management practice.

There is an important debate in the wildlife management regarding the use of lethal force on poachers as a deterrence policy [32]. Prior scholars concluded that targeted killings of poachers are a legitimate tool in enforcing anti-poaching laws that could prevent the extinction of wildlife populations [36]. Sentiments are considered common in the war against biodiversity loss [32, 36]. However, there is a counter argument that armed forces lead to deforestation, habitat destruction, and displacement of certain indigenous communities [13]. Furthermore, prior research indicated that using lethal force to protect wildlife is an extreme example of conservation action and concluded that justifying killing poachers fails both ethical and pragmatic examination [9]. Lethal force policies are likely to fail because sustainable conservation depends on the support of local communities and stakeholders [10].

In Assam, a similar debate is taking place regarding the use of lethal force. Between 2014 to 2017, 50 poachers were killed to protect the greater one-horned rhino in Kaziranga National Park, and rangers were ordered to shoot poachers on sight [9]. Thus, the statement 'I think killing poachers is an effective tool at preventing poaching' was asked. The survey participants' responses showed a large, significant difference in stakeholders' perception regarding killing poachers. In general, most villagers disagreed with this statement; however, there was some agreement among the groups. For example, villagers near Kaziranga National Park showed stronger agreement with the statement than Forest Staff, East Karbi Anglong Wildlife Sanctuary, Manas and Nameri National Parks. Additionally, villagers near Orang National Park showed stronger agreement with the survey statement than Manas and East Karbi Anglong Wildlife Sanctuary. Based on this survey, it can be concluded that forest villagers' perception of using lethal force is mixed, while Forest Staff do not think lethal force is an effective tool for preventing poaching in Assam.

However, it is questionable why villagers near Kaziranga and Orang National Parks are more receptive to the lethal force approach. A possible explanation for these results might be that both Kaziranga and Orang have significant ecotourism industries [6, 8]. Ecotourism can increase economic devel-

opment in Assam [8, 39] and yield additional income to local communities [8]. According to Directorate of Tourism, Government of Assam approximately Rs. 14,470 lakhs ($17,532,228.22 USD) in 2019 and Rs. 6,797 lakhs ($8,235,421.92 USD) in 2020-2021was generated by ecotourism. More importantly, ecotourism provides additional jobs in the form of tour operators, jeep safaris, selling crafts, and hospitality services [6]. Since the ecotourism industry is providing alternative livelihoods to Orang and Kaziranga communities [30], villagers could have more likely agreed that the use of lethal force as an anti-poaching management practice as an effective way to prevent poaching.

It is known that religion plays an important role in wildlife conservation. Religion influences human behavior by providing ethical and social models for living respectfully with nature, it provides primary understanding about right and wrong, and nature is spiritual and must be respected noted [40]. Tribal customs generally rely on religion and play a crucial role in creating social conduct. Social conduct may dictate human behavior and influence wildlife poaching decisions. In this context, the statement about how forest villagers and forest staff perceive the role of tribal customs in poaching management.

The survey participants indicated mixed responses regarding the statement, 'I think there are tribal customs that prevent poaching,' and the responses were statistically significantly different. Overall, villagers near Manas and Nameri National Parks did not believe that tribal customs play a role in poaching management. To better understand, it is noteworthy to mention the civil unrest that occurred in Manas National Park/Tiger Reserve between the mid-1980s and 2003. The civil unrest arose from social, political, and economic issues that caused nearly 90% decrease (or local extinction) in wild rhino populations, and a sharp decrease in wild tiger populations Unfortunately, during this period, the Forest Department ceased all wildlife management activities (e.g., patrolling) and abandoned Manas National Park/Tiger Reserve [12]. Amidst the strong civil unrest, tribal customs appear not to play a strong role in managing poaching nor mitigate the absence of the Forest Department's enforcement activities to patrol the park and punish poachers.

## 6. Policy Implications

This research evaluates stakeholders' perceptions regarding anti-poaching management practices for good governance. It is understood that good governance respecting diverse stakeholders' interests and perspectives is key to safeguarding endangered species, such as wild tigers, rhinos, and elephants. The research findings indicate that a strong presence of the Forest Department may promote confidence and give the perception of effectiveness at preventing poaching. Likewise, so does patrolling by forest staff. Policymakers should consider strengthening the presence of the Forest Department in protected areas where their presence is diminished as a good governance practice as this practice may deter wildlife poaching. Furthermore, according to the findings, the use of lethal force on poachers was not supported by some stakeholders, while some villagers agreed on it. Policymakers and forest managers should thus take a cautious approach when employing lethal force against poachers, although this practice may safeguard wildlife for ecotourism benefits. Lastly, as mixed responses regarding tribal customs preventing poaching were reported, policymakers and forest managers alike should not assume tribal customs relying on religion would play a critical role in wildlife poaching in fringe villages of the Global South. This result rather reinforces the reason to strengthen enforcement capacity by park management agencies and international conservation policy regimes for wildlife management in emerging economies [12].

## 7. Limitation of the Research

Relying on novel data from fringe villagers around India's national parks and wildlife sanctuary as well as forest management staff, this research examined how anti-poaching management practices are perceived. Despite its unique dataset and insightful results, the research has some limitations. First, the global health crisis with COVID-19 affected data collection, as the survey was undertaken during the second wave of COVID-19 in Assam, India. This caused the challenges of accessing certain villages around the national parks, leading to a modest sample size used in the research. Secondly, since the survey was translated from English to the Assamese tribal language, it could be a possibility that some statements could not have been clearly interpreted to some villagers whose knowledge about poaching management is limited. Third, the survey was designed to include both males and females equally, but the majority of participants who consented were males and/or head-of-household, which leaves us the question of how women would perceive the anti-poaching practices. Furthermore, detailed demographic information about survey participants was not collected due to local villagers' skeptical attitudes toward outsiders. Lastly, all answers were self-reported and may be prone to human biases and limitations.

## 8. Conclusion

Oftentimes, wildlife conservation policy is based on increasing wildlife habitat, mitigating poaching, and reducing human/wildlife conflict [14, 25, 28, 34, 47]. Some of these policies are at odds with stakeholders' interests and activities [37, 49]. This research contributes to a better understanding about stakeholders' perceptions about anti-poaching management practices in India. Prior studies of forest-dependent communities have largely focused on their beliefs regarding wildlife, environment, livelihood, or tribal customs in the form of religion [24, 26, 31]. The novelty of this research

focused on these communities' understanding of and buy-in capacity for anti-poaching management practices. A major strength of this survey is that it successfully demonstrated the varying degrees of stakeholders' responses, while also showing these communities, in general, support the Assam Forest Department and their anti-poaching management efforts. As some anti-poaching management approaches are deterrence-based, earning local communities' support for wildlife management practices would be essential for government-driven wildlife conservation in highly protected areas.

## Abbreviations

CFs: Conservators of Forest
FDs: Field Directors
DFOs: Division Field Officers
HoFF: Head of Forest Force
PCCF: Principle Chief Conservator of Forest (PCCF)
UNESCO: United Nations Educational, Scientific and Cultural Organization

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

[1] Altman, J., & Cochrane, M. (2005). Sustainable development in the indigenous-owned savanna: Innovative institutional design for cooperative wildlife management. *Wildlife Research*, *32*(5), 473–480. https://doi.org/10.1071/WR04074

[2] Annecke, W., & Masubelele, M. (2016). A review of the impact of militarisation: The case of rhino poaching in Kruger National Park, South Africa. *Conservation and Society*, *14*(3), 195–204.

[3] Assam Project on Forest and Biodiversity Conservation. (2018). *Evaluation of Assam Project on Forest and Biodiversity Conservation (APFBC) followed by Drafting of Phase II of the Project.* http://www.Evaluation-Report-APFBC%20Nov%202018.pdf

[4] Assam State Biodiversity Board. (2022). *Assam State Biodiversity Strategy and Action Plan 2017-2030*. Assam State Biodiversity Board. https://www.asbb.gov.in/booklets/ASBSAP%20Report%20(2).pdf

[5] Dang Vu, H. N., & Nielsen, M. R. (2018). Understanding utilitarian and hedonic values determining the demand for rhino horn in Vietnam. *Human Dimensions of Wildlife*, *23*(5), 417–432. https://doi.org/10.1080/10871209.2018.1449038

[6] Das, D., & Hussain, I. (2016). Does ecotourism affect economic welfare? Evidence from Kaziranga National Park, India. *Journal of Ecotourism*, *15*(3), 241–260. https://doi.org/10.1080/14724049.2016.1192180

[7] Decker, D. J., Forstchen, A. B., Pomeranz, E. F., Smith, C. A., Riley, S. J., Jacobson, C. A., Organ, J. F., & Batcheller, G. R. (2015). Stakeholder engagement in wildlife management: Does the public trust doctrine imply limits? *Journal of Wildlife Management*, *79*(2), 174–179. https://doi.org/10.1002/jwmg.809

[8] Devi, M. K. (2012). Ecotourism in assam: A promising opportunity for development. *South Asian Journal of Tourism and Heritage*, *5*(1), 179–192.

[9] Dickman, A., Johnson, P., Coals, P., Harrington, L., Tyrrell, P., Somerville, K., Cotterill, A., & Whetham, D. (2020). Wars over Wildlife: Green Militarisation and Just War Theory. *Conservation and Society*, *18*(3), 293. https://doi.org/10.4103/cs.cs_19_34

[10] Duffy, R., St John, F. A., Büscher, B., & Brockington, D. A. N. (2015). The militarization of anti-poaching: Undermining long term goals? *Environmental Conservation*, *42*(4), 345–348. https://doi.org/10.1017/S0376892915000119

[11] Dunn, O. J. (1964). Multiple comparisons using rank sums. *Technometrics*, *6*(3), 241–252.

[12] Dutta, A. (2020). Forest becomes frontline: Conservation and counter-insurgency in a space of violent conflict in Assam, Northeast India. *Political Geography*, *77*, 102117. https://doi.org/10.1016/j.polgeo.2019.102117

[13] Dutta, A., & Simlai, T. (2022). If the Army Cuts Trees, Why Can't We? Resource Extraction, Hunting and the Impacts of Militaries on Biodiversity Conservation. In *Enforcing Ecocide* (pp. 199–225). Springer.

[14] Frank, B., & Glikman, J. A. (2019). Human-wildlife conflicts and the need to include coexistence. *Human–Wildlife Interactions: Turning Conflict into Coexistence*, *23*, 1–19.

[15] Gogoi, D., & Gogoi, B. (2022). Endangering the Endangered: The Poaching and Conservation Conundrum Facing the Greater Indian One-Horned Rhinoceros in Kaziranga National Park, Assam, India. *Journal of International Wildlife Law & Policy*, 1–17. https://doi.org/10.1080/13880292.2022.2124609

[16] Gogoi, M. (2018). Emotional coping among communities affected by wildlife–caused damage in north-east India: Opportunities for building tolerance and improving conservation outcomes. *Oryx*, *52*(2), 214–219. https://doi.org/10.1017/S0030605317001193

[17] Gosling, J. (2018). Skinned, the growing appetite for Asian elephants. *An Investigative Report from Elephant Family*.

[18] Government of Assam--Environment and Forest. (2022). *National Parks*. National Park | Environment & Forest | Government of Assam, India. https://environmentandforest.assam.gov.in/information-services/national-park

[19] Haas, T. C., & Ferreira, S. M. (2016). Combating Rhino Horn Trafficking: The Need to Disrupt Criminal Networks. *PLOS ONE*, *11*(11), e0167040. https://doi.org/10.1371/journal.pone.0167040

[20] Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, 65–70.

[21] Hotte, M. H. H., Kolodin, I. A., Bereznuk, S. L., Slaght, J. C., Kerley, L. L., Soutyrina, S. V., Salkina, G. P., Zaumyslova, O. Y., Stokes, E. J., & Miquelle, D. G. (2016). Indicators of success for smart law enforcement in protected areas: A case study for Russian Amur tiger (*Panthera tigris altaica*) reserves. *Integrative Zoology*, *11*(1), 2–15. https://doi.org/10.1111/1749-4877.12168

[22] IFAW, K. (2010). *Ivory market in China: China ivory trade survey report.* International fund for animal welfare.

[23] Jamieson, S. (2004). Likert scales: How to (ab) use them? *Medical Education*, *38*(12), 1217–1218. https://doi.org/10.1111/j.1365-2929.2005.02237.x

[24] Janaki, M., Pandit, R., & Sharma, R. K. (2021). The role of traditional belief systems in conserving biological diversity in the Eastern Himalaya Eco-region of India. *Human Dimensions of Wildlife*, *26*(1), 13–30. https://doi.org/10.1080/10871209.2020.1781982

[25] Jhala, Y., Gopal, R., Mathur, V., Ghosh, P., Negi, H. S., Narain, S., Yadav, S. P., Malik, A., Garawad, R., & Qureshi, Q. (2021). Recovery of tigers in India: Critical introspection and potential lessons. *People and Nature*, *3*(2), 281–293. https://doi.org/10.1002/pan3.10177

[26] Juntadach, S., Sponsel, L. E., Natadecha-Sponsel, P., & Ruttanadakul, N. (1998). Sacred and/or secular approaches to biodiversity conservation in Thailand. *Worldviews: Global Religions, Culture, and Ecology*, *2*(2), 155–167.

[27] Kiruba-Sankar, R., Lohith Kumar, K., Saravanan, K., & Praveenraj, J. (2019). Poaching in Andaman and Nicobar coasts: Insights. *Journal of Coastal Conservation*, *23*(1), 95–109.

[28] Kothari, A., Suri, S., & Singh, N. (1995). Conservation in India: A new direction. *Economic and Political Weekly*, 2755–2766.

[29] Kruskal, W. H., & Wallis, W. A. (1952). Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association*, *47*(260), 583–621. https://doi.org/10.2307/2280779

[30] Kummitha, H. R. (2020). Stakeholders involvement towards sustaining ecotourism destinations: The case of social entrepreneurship at mangalajodi ecotourism trust in India. *Geo Journal of Tourism and Geosites*, *29*(2), 636–648. https://doi.org/10.14321/aehm.024.02.13

[31] Lepcha, L. D., Shukla, G., Pala, N. A., Vineeta, Pal, P. K., & Chakravarty, S. (2019). Contribution of NTFPs on livelihood of forest-fringe communities in Jaldapara National Park, India. *Journal of Sustainable Forestry*, *38*(3), 213–229. https://doi.org/10.1080/10549811.2018.1528158

[32] Louchouarn, N., Santiago-Ávila, F. J., Parsons, D. R., & Treves, A. (2021). *Supplementary material from "Evaluating how lethal management affects poaching of Mexican wolves."* https://doi.org/10.6084/M9.FIGSHARE.C.5324949.V1

[33] Mangattuthazhe, T. (2008). *Violence and search for peace in Karbi Anglong, Assam*. Guwahati: NESRC.

[34] Milda, D., Ramesh, T., Kalle, R., Gayathri, V., & Thanikodi, M. (2020). Ranger survey reveals conservation issues across Protected and outside Protected Areas in southern India. *Global Ecology and Conservation*, *24*, e01256. https://doi.org/10.1016/j.gecco.2020.e01256

[35] Mishra, M. (2002). Evolution, impact, and effectiveness of domestic wildlife trade ban in India. *The Trade in Wildlife: Regulation for Conservation. Earthscan, London, United Kingdom*, 78–88.

[36] Mogomotsi, G. E., & Mogomotsi, P. K. (2021). Law of Armed Conflict in Non-International Hostilities: The Militarisation of Wildlife Conservation in Africa. *Journal of International Wildlife Law & Policy*, *24*(3–4), 366–384. https://doi.org/10.1080/13880292.2021.2059239

[37] Moilanen, A., Anderson, B. J., Eigenbrod, F., Heinemeyer, A., Roy, D. B., Gillings, S., Armsworth, P. R., Gaston, K. J., & Thomas, C. D. (2011). Balancing alternative land uses in conservation prioritization. *Ecological Applications*, *21*(5), 1419–1426. https://doi.org/10.1890/10-1865.1

[38] Moreto, W. D., & Matusiak, M. C. (2017). "We fight against wrong doers": Law enforcement rangers' roles, responsibilities, and patrol operations in Uganda. *Deviant Behavior*, *38*(4), 426–447. https://doi.org/10.1080/01639625.2016.1197015

[39] Nath, H. K. (2019). Ecotourism and Economic Development. *Available at SSRN 3488557*.

[40] Negi, C. S. (2005). Religion and biodiversity conservation: Not a mere analogy. *The International Journal of Biodiversity Science and Management*, *1*(2), 85–96. https://doi.org/10.1080/17451590509618083

[41] Niraj, S. K., Krausman, P. R., & Dayal, V. (2012). A stakeholder perspective into wildlife policy in India. *The Journal of Wildlife Management*, *76*(1), 10–18. https://doi.org/10.1002/jwmg.263

[42] Constitution of India, Sixth Schedule (1952). https://www.mea.gov.in/Images/pdf1/S6.pdf

[43] Patankar, V. J. (2019). Attitude, perception and awareness of stakeholders towards the protected marine species in the Andaman Islands. *Ocean & Coastal Management*, *179*, 104830. https://doi.org/10.1016/j.ocecoaman.2019.104830

[44] Patil, I. (2021). Visualizations with statistical details: The'ggstatsplot'approach. *Journal of Open Source Software*, *6*(61), 3167. https://doi.org/10.21105/joss.03167

[45] Pell, G. (2005). *Use and misuse of Likert scales.*

[46] R Core Team. (2022). *R: A language and environment for statistical computing.* R Foundation for Statistical Computing. https://www.R-project.org/

[47] Raman, T. S. (2011). Framing ecologically sound policy on linear intrusions affecting wildlife habitats. *Nature Conservation Foundation, Mysuru, India*.

[48] Seidensticker, J. (2010). Saving wild tigers: A case study in biodiversity loss and challenges to be met for recovery beyond 2010. *Integrative Zoology*, *5*(4), 285–299. https://doi.org/10.1111/j.1749-4877.2010.00214.x

[49] Shackelford, G. E., Steward, P. R., German, R. N., Sait, S. M., & Benton, T. G. (2015). Conservation planning in agricultural landscapes: Hotspots of conflict between agriculture and nature. *Diversity and Distributions*, *21*(3), 357–367. https://doi.org/10.1111/ddi.12291

[50] Siemer, W. F., & Decker, D. J. (2006). *An assessment of black bear impacts in New York. Human Dimensions Research Unit Series Publication 06–6, Department of Natural Resources*.

[51] Singh, T. P., & Hegde, R. (2004). Stakeholder analysis in joint forest management in India: A case study of Haryana Shivaliks. *Environmental Economics in Practice. Oxford University Press, Delhi, India*, 204–239.

[52] Talukdar, B. K. (2003). Importance of anti-poaching measures towards successful conservation and protection of rhinos and elephants, north-eastern India. *Pachyderm*, *34*, 59–65.

[53] United Nations Office of Drug and Crime. (2020). *World Wildlife Crime Report*. United Nations.

[54] UNODC. (2010). *The globalization of crime: A transnational organized crime threat assessment*. United Nations Office on Drugs and Crime.

[55] Weeks, P., & Mehta, S. (2004). Managing people and landscapes: IUCN's protected area categories. *Journal of Human Ecology*, *16*(4), 253–263. https://doi.org/10.1080/09709274.2004.11905747

[56] Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis* (2nd ed. 2016). Springer International Publishing : Imprint: Springer. https://doi.org/10.1007/978-3-319-24277-4

[57] World Wildlife Fund for Nature. (2018). *LIFE ON THE FRONTLINE 2018 A global survey of the working conditions of rangers*. http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_rangers_survey_report_181005_hires_page_2.pdf

[58] WWF-India. (2021). *Caretakers of Conservation*. Recognizing the Efforts of Forest Frontline Workers as Caretakers of Conservation. https://www.wwfindia.org/?20222/Recognizing-the-efforts-of-forest-frontline-workers-as-caretakers-of-conservation

1 Self-governing authority has judicial, executive, and legislative powers. Diminished Forest Department presence.