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Human–Snake Interaction and Behavioural Transition in Rural Landscapes: A Community-Based Study from Nagaon District, Assam, India

Dr. Smarajit Ojah
Assistant Professor, Department of Geography, Nowgong Girls' College, Nagaon, Assam

Abstract

Human–snake interactions are common in tropical agrarian and wetland-associated landscapes, where habitat overlap increases the frequency of encounters and snakebite risk. Fear, cultural beliefs, and poor knowledge often lead to snake killings, delayed treatment, and preventable morbidity or mortality. The present study investigates the perception, knowledge, behavioural response patterns, and conservation attitudes of communities living in three settlements, *viz.* Ranthali, Jamuguri, and Laokhowa, situated in the Nagaon district of Assam. Data were collected using structured household interviews with 150 respondents, supported by qualitative interpretation and secondary verification. Findings reveal that while fear remains widespread, there has been a notable shift in response from killing snakes to calling rescue volunteers, supported by community awareness and demonstrative learning. Misidentification of non-venomous species such as *Ptyas mucosa* persists, particularly among older respondents. Understanding of correct snakebite first-aid remains limited, with traditional and potentially harmful practices still present. Although most people express positive conservation attitudes, active participation and accountability remain moderate. The study concludes that coexistence potential has strengthened, but effective community-centred training, official recognition of rescuers, and school-linked education programmes are required to sustain and scale positive behavioural trends in northeastern India.

Keywords: Human–snake conflict; behavioural transition; rescue awareness; perception; Assam

Introduction

Human–snake interactions represent a complex interface between biodiversity, public health, and traditional belief systems, particularly in tropical agrarian regions where human activities overlap with natural reptile habitats (Longbottom et al., 2018; Whitaker & Captain, 2004). In many Asian and global contexts, snakes evoke mixed emotions ranging from sacred reverence to intense fear, and attitudes towards snakes are strongly shaped by perceived risk and cultural representations (Kontsiotis et al., 2022; Vaughn et al., 2022). Fear-based perception often dominates real-world interactions and influences behavioural responses, leading to snake killing, delayed medical intervention, and persistent reliance on traditional healing (Mohapatra et al., 2011; Suraweera et al., 2020; Afroz et al., 2023). The World Health Organization has categorised snakebite as a neglected tropical health concern, particularly in low-income communities where occupational exposure is high and healthcare access is limited (World Health Organization, 2017).

India accounts for one of the highest global snakebite mortality burdens, with tens of thousands of deaths annually, predominantly affecting rural agrarian populations (Longbottom et al., 2018; Suraweera et al., 2020). Assam, located within the Indo-Burma global biodiversity hotspot, supports diverse herpetofauna, including medically significant species such as *Naja kaouthia*, *Bungarus caeruleus,* and *B. fasciatus*, alongside numerous harmless taxa such as *Ptyas mucosa*, *Xenochrophis piscator*, *Lycodon* spp., and *Python molurus* (Das, 2002; Whitaker & Captain, 2004). The humid climate, extensive paddy fields, bamboo groves, wetlands, and livestock sheds create favourable conditions for both venomous and non-venomous snakes, thereby increasing human encounter probability in agrarian landscapes.

Fear-driven interaction outcomes are frequently reinforced by culturally embedded beliefs, which influence decision-making during encounters and shape risk perception (Basak et al., 2023; Sinha et al., 2023). At the same time, evolving conservation and human–wildlife conflict literature indicates that attitudes and behavioural responses to snakes are highly context-specific, influenced by social–ecological conditions, knowledge, and prior experience (Bateman et al., 2021; Vaughn et al., 2022). Recent studies suggest emerging behavioural shifts linked to improved awareness, school-based sensitisation, digital communication, and decentralised wildlife rescue or removal networks, where trained individuals support safe responses during encounters (Bateman et al., 2021; Basak et al., 2023; Jayathilaka & Weeratunga, 2024). In this context, rural Nagaon is a relevant study location due to its ecological characteristics, proximity to Laokhowa Wildlife Sanctuary, and increasing presence of trained community-level rescuers.

This study aims to examine community-level perception, knowledge, behavioural responses, and conservation attitudes towards snakes across three ecologically similar but socially dynamic villages, *viz.* Ranthali, Jamuguri, and Laokhowa, in the Nagaon district of Assam. It analyses the behavioural transition from lethal to rescue-based response, interprets relationships among perception, fear, superstition, and education, and discusses implications for coexistence and conservation planning. Unlike many earlier studies that primarily focused on snakebite epidemiology or medical outcomes, this research emphasises socio-psychological drivers behind attitudes and decision-making in a rural Indian context.

The study area lies within the Brahmaputra floodplain between 25°45′N–26°45′N latitude and 92°33′E–93°30′E longitude. The landscape is characterised by fertile alluvial soils, wet paddy fields, homestead vegetation, seasonal wetlands, and irrigation channels. Annual rainfall exceeds 1800 mm, with monsoon months contributing to peak flooding and increased displacement of snakes from natural shelters into human habitation zones. Ranthali and Jamuguri represent typical agrarian settlements dependent on rice cultivation, cattle rearing, and homestead gardens dominated by bamboo and banana groves, which provide humid shelter favourable to snakes. Laokhowa is located adjacent to the Laokhowa Wildlife Sanctuary, resulting in higher ecological species diversity and greater exposure to semi-natural habitats. Demographically, the settlements include heterogeneous socio-economic groups with varying educational backgrounds. Mobile connectivity and school attendance have increased over recent years, creating a fertile context for evaluating changing knowledge, risk perception, and behaviour.

Methodology

A descriptive, cross-sectional research design was adopted, incorporating both quantitative and qualitative components. Primary data were collected from 150 households (50 per village) during March–April 2024. Respondents were selected through simple random sampling, ensuring representation of age, gender, and occupation, following principles outlined by Newing (2011). A structured questionnaire containing closed and open-ended questions was employed to collect information related to encounter frequency, species recognition, perception, belief systems, first-aid knowledge, historical and current behavioural responses, and conservation attitudes. The questionnaire was first prepared in English and then translated into Assamese, with minor phrasing adaptations to ensure cultural and linguistic clarity. A brief piloting exercise in a non-sample cluster was used to refine wording, response options, and the sequencing of sensitive questions.

Survey data were complemented by informal discussions with local volunteer rescuers trained under forest department guidance. Qualitative responses were coded thematically to triangulate behavioural patterns with perception and belief-based constructs and to capture nuanced explanations behind closed-ended choices. Descriptive statistics (percent, comparison, and settlement-wise rankings) were used as analytical techniques, primarily using spreadsheet-based tabulation. Ethical considerations included informed consent, participant anonymity, and voluntary participation. Care was taken to minimise recall bias by focusing questions on recent and clearly remembered events. No wildlife handling or intervention was undertaken. Species identity information was validated using the *Snakes of India* field guide (Whitaker & Captain, 2004) and cross-checked with rescuers' photographic records where available.

Results

Human–snake encounters were reported by a large majority of respondents: 92 percent in Ranthali, 88 percent in Jamuguri, and 90 percent in Laokhowa. The most frequently cited locations included crop fields, cattle sheds, homestead courtyards, bamboo groves, and water-logged household floors during the monsoon. High encounter frequency influenced emotional and behavioural responses, which varied by settlement, particularly in relation to occupation, daily activity patterns, and proximity to vegetation. In addition, respondents highlighted that encounters were more common during early morning and late evening hours, when both agricultural and domestic tasks overlap with peak movement periods of snakes, increasing the likelihood of sudden and close-range interactions.

Reaction Type	Ranthali	Jamuguri	Laokhowa	Overall
Kill immediately	78%	70%	72%	73%
Try to identify	10%	18%	13%	12%
Run away	8%	7%	15%	10%
Call for help	4%	5%	0%	5%

Table 1. Immediate reaction to snake encounters in three settlements

Analysis shows that killing was the dominant historic response, especially in Ranthali, where fear and traditional beliefs appear to have shaped long-standing reaction norms. Jamuguri showed the highest tendency to identify species, potentially linked to school-based awareness exposure, interaction with youth volunteers, and better access to environmental learning. Laokhowa showed the highest flee-based behaviour (15%), suggesting strong avoidance even though rescue information is available and accessible through community networks. Behavioural shifts over time were analysed using past versus current response comparison to examine the degree of attitudinal and practical transformation among households.

Village	Earlier Kill (%)	Currently Call Rescue (%)
Ranthali	78	85
Jamuguri	70	90
Laokhowa	72	88

Table 2. Behavioural transition from past to present

The village-wise species distribution indicates a shared human–snake interface across the three settlements, with *Naja kaouthia* and *Ptyas mucosa* occurring in all villages, reflecting broad ecological suitability across homestead vegetation, agricultural fields, and water-linked microhabitats. Ranthali shows the widest diversity, including *Python molurus* and unidentified *Xenochrophis* species, suggesting extensive vegetated patches, bamboo groves,

and livestock sheds that support both arboreal and ground-dwelling taxa. Laokhowa records a higher concentration of medically significant species, including *Bungarus fasciatus* and *Xenochrophis piscator*, which is consistent with its proximity to wetland–forest ecotones and semi-natural habitats near the sanctuary landscape. Jamuguri, by contrast, features comparatively fewer venomous species and a stronger presence of non-venomous taxa such as *Amphiesma stolatum*, aligning with reported higher identification awareness and reduced panic responses.

Group	Common Name	Scientific Name	Villages Reported	Venom Status	WPA* Schedule	IUCN* Status
Venomous	Monocled Cobra	*Naja kaouthia*	Ranthali, Jamuguri, Laokhowa	Venomous	II	Least Concern
	Common Krait	*Bungarus caeruleus*	Ranthali, Jamuguri	Venomous	IV	Least Concern
	Banded Krait	*Bungarus fasciatus*	Laokhowa	Venomous	IV	Least Concern
Non-Venomous	Indian Rat Snake	*Ptyas mucosa*	Ranthali, Jamuguri, Laokhowa	Non-venomous	II	Least Concern
	Indian Rock Python	*Python molurus*	Ranthali	Non-venomous	I	Near Threatened
	Checkered Keelback	*Xenochrophis piscator*	Laokhowa	Non-venomous	II	Least Concern
	Keelback (Unidentified)	*Xenochrophis* spp.	Ranthali	Non-venomous	II	Least Concern
	Buff-Striped Keelback	*Amphiesma stolatum*	Jamuguri	Non-venomous	II	Least Concern
	Common Wolf Snake	*Lycodon aulicus*	Laokhowa	Non-venomous	II	Least Concern

Table 3. Species encountered and rescued

*WPA refers to the Wildlife Protection Act, 1972, which governs legal protection and conservation status of species in India, while IUCN stands for the International Union for Conservation of Nature, the global authority that categorises species based on extinction risk through the Red List assessment.

The ecological perception data reveal varying levels of awareness among the three villages regarding the functional role of snakes. Laokhowa shows the strongest recognition of rodent control and ecological balance, possibly influenced by proximity to protected areas where wildlife awareness is comparatively higher. Jamuguri also reflects a relatively positive understanding, aligning with earlier findings on school-based exposure and awareness activities. Ranthali demonstrates comparatively lower ecological perception and a higher proportion of respondents considering snakes solely harmful, suggesting stronger fear-based attitudes. The overall responses indicate mixed ecological awareness, with utilitarian understanding being more common than systems-based ecological reasoning, a pattern also observed in other rural settings (Sinha et al., 2023).

Ecological Perception	Ranthali	Jamuguri	Laokhowa	Overall
Control rodent population	60%	68%	75%	68%
Maintain ecological balance	48%	58%	60%	55%
Harmful / Only dangerous	32%	22%	18%	24%

Table 4. Ecological role perception

The influence of belief systems and superstition is evident across the three settlements, where traditional narratives continue to shape emotional responses and perceptions regarding snakes. Ranthali records the highest

impact of myths on fear and the strongest exposure to inherited belief systems, indicating deeper cultural embedding. Jamuguri reflects slightly lower values, suggesting moderating effects of awareness activities and school-based environmental learning. Laokhowa shows the lowest reported influence, which may be associated with greater ecological familiarity due to proximity to forest–wetland habitats. Overall, the data suggest that cultural and supernatural interpretations continue to coexist alongside scientific awareness as parallel knowledge systems, mirroring patterns reported in other human–wildlife conflict contexts (Basak et al., 2023; Sinha et al., 2023).

Belief Parameter	Ranthali	Jamuguri	Laokhowa	Overall
Myths influence fear	65%	55%	50%	61%
Heard traditional beliefs	72%	68%	55%	65%

Table 5. Influence of superstitions on perception

non-medical and potentially harmful methods across the three villages. Although seeking medical help is the most preferred response overall (40 percent), a considerable proportion of respondents still opt for traditional practices such as applying a tourniquet (27 percent) or using herbal remedies (13 percent), indicating partial acceptance of biomedical treatment. Laokhowa records the highest tendency towards cut or suction attempts (24 percent), suggesting persistent misconceptions linked to rural experiential knowledge. Jamuguri reflects comparatively higher inclination toward hospital-based treatment, aligning with earlier awareness indicators, yet outdated responses remain widely prevalent. Similar patterns of mixed treatment-seeking behaviour and reliance on unproven methods have been documented in other parts of India and South Asia (Das et al., 2021; Afroz et al., 2023).

Response Type	Ranthali	Jamuguri	Laokhowa	Overall
Seek medical help	35%	45%	40%	40%
Apply tourniquet	30%	25%	26%	27%
Use herbal remedies	18%	15%	10%	13%
Cut or suction attempt	17%	15%	24%	15%

Table 6. Preferred first-aid response

The conservation response pattern suggests generally positive attitudes toward snake protection across all three villages, with the strongest support emerging from Jamuguri, which aligns with earlier indicators of higher awareness and species identification ability. Legal protection receives the highest endorsement overall (84 percent), reflecting broad conceptual agreement with non-lethal approaches. However, the lower percentage for willingness to participate (63 percent) indicates that while communities favour protection in principle, many remain hesitant to engage practically, possibly due to fear, lack of skills, or uncertainty regarding procedures. Ranthali consistently shows comparatively weaker conservation inclination, while Laokhowa reflects moderate yet encouraging support trends. These attitudinal gradients echo broader findings that tolerance and willingness to coexist with snakes and other wildlife are shaped by knowledge, perceived control, and context-specific risk perception (Vaughn et al., 2022; Kontsiotis et al., 2022).

Conservation Parameter	Ranthali	Jamuguri	Laokhowa	Overall
Support legal protection	78%	88%	85%	84%
Oppose killing	70%	82%	76%	76%
Willing to participate	55%	70%	63%	63%

Table 7. Conservation attitude levels

Discussion

The results of the present study provide insights into how human–snake interaction patterns, perception, knowledge, and behavioural responses are shaped by socio-cultural, ecological, and experiential factors across three agrarian settlements in Nagaon district. The high encounter rate across all villages is consistent with floodplain agro-ecosystems, where waterlogged soils, livestock sheds, bamboo groves, and peri-domestic vegetation create favourable microhabitats for both venomous and non-venomous snakes. The variation in encounter settings and frequency suggests that daily livelihood practices' structure exposure levels, particularly during early morning and evening hours, when both agricultural and domestic routines overlap with natural snake activity periods.

The analysis of immediate reactions to snake sightings reveals that fear remains a dominant emotional driver, particularly in Ranthali, where killing as an instinctive response is rooted in both long-standing community narratives and limited species identification capability. Jamuguri, however, reflects an encouraging tendency towards species identification and rescue-oriented decisions, echoing the role of school-based awareness and exposure to volunteer demonstration. Laokhowa, located adjacent to semi-natural landscapes, shows a preference towards avoidance rather than confrontation or identification, suggesting a caution-based strategy rather than hostility. These findings align with broader research that emphasises heterogeneity in community responses based on the interaction between lived experience, learning pathways, and perceived self-efficacy (Bateman et al., 2021; Basak et al., 2023; Sinha et al., 2023).

The documented presence of *Naja kaouthia* and *Bungarus* species across the settlements confirms that the landscape represents a medically significant snakebite zone, consistent with national vulnerability patterns (Longbottom et al., 2018; Suraweera et al., 2020). However, the greater proportion of non-venomous species encountered and rescued reinforces the argument that many lethal responses originate from misidentification rather than the actual threat posed. This supports the need for practical and visual identification literacy rather than purely theoretical awareness, especially in communities where rapid decision-making occurs without expert consultation. Misidentification and low tolerance are widely recognised drivers of unnecessary killing of snakes and other wildlife (Vaughn et al., 2022; Kontsiotis et al., 2022). Moreover, the species-wise distribution suggests that Ranthali's higher diversity, including *Python molurus*, may be associated with dense vegetation, cattle sheds, and low-disturbance microhabitats, while Laokhowa's diversity aligns with its protected-area edge habitat.

Ecological perception findings demonstrate partial awareness, where snakes are acknowledged for rodent control, yet systems-level ecological understanding remains limited. Such a "utilitarian conservation mindset" supports snakes only so far as they offer economic or household benefit. This is consistent with literature indicating that favourable attitudes do not always translate into deep ecological empathy or active support for conservation (Basak et al., 2023; Vaughn et al., 2022). Moreover, fear persists even among respondents recognising positive ecological roles, highlighting that knowledge alone does not dissolve entrenched emotional frameworks.

The influence of belief systems remains a significant perceptual force, especially in Ranthali. While traditional knowledge can contribute positively to ecological coexistence, fear-intensifying narratives do not contribute to informed decision-making. However, rather than dismissing these beliefs, community-based messaging must

adopt culturally sensitive dialogue, recognising that belief systems coexist with emerging scientific knowledge and must evolve through reframing rather than rejection (Basak et al., 2023; Sinha et al., 2023). Laokhowa's reduced influence of myths may be attributed to proximity to natural ecosystems and observational familiarity, which reduces the psychological novelty component of animal encounters.

First-aid response patterns further highlight a critical intervention gap. Although medical treatment emerged as the majority response, a sizeable proportion still engages in outdated or harmful procedures such as tourniquets, herbal applications, or incision-based suction. This reflects incomplete transmission of recommended snakebite management protocols and mirrors patterns documented in other Indian and South Asian settings (Das et al., 2021; Afroz et al., 2023; Jayathilaka & Weeratunga, 2024). It signals the need for integration of public-health education into conservation awareness rather than treating them as separate domains.

The positive conservation attitudes observed across all villages reveal strong ideological support for snake protection; however, willingness to participate in practical conservation activities is comparatively lower. This disparity reflects a typical "attitude–behaviour gap", where fear, risk perception, lack of procedural clarity, and absence of official recognition inhibit active engagement (Vaughn et al., 2022; Kontsiotis et al., 2022). The relatively higher willingness in Jamuguri aligns with exposure-driven learning and visibility of rescue role models, suggesting the importance of peer-based influence mechanisms and education-based interventions (Sinha et al., 2023; Jayathilaka & Weeratunga, 2024). Collectively, the results indicate that behavioural transition towards coexistence is underway but requires reinforcement through enabling structures such as training, safety kits, hotline systems, and community-recognised rescue frameworks.

Conclusion

The present study underscores that human–snake interactions in rural Nagaon are shaped by a close overlap of ecological space and agrarian livelihoods, where human activities take place in habitats naturally favoured by snakes. Although fear remains deeply rooted in cultural memory and lived experience, behavioural patterns have begun shifting towards more informed and non-lethal practices, indicating that coexistence is emerging as a realistic possibility rather than a theoretical expectation. This shift appears to be influenced not only by awareness dissemination but also by visual demonstrations, peer influence, mobile-based communication, and increased social acceptance of rescue interventions. The persistence of fear alongside behavioural change suggests that emotional, cognitive, and behavioural transformation unfold at different rates, where action may evolve more rapidly than perception or belief.

Differences observed across villages affirm that behavioural transition is not uniform; instead, it is shaped by context-specific factors such as educational exposure, proximity to natural landscapes, community belief structures, and social learning opportunities. Positive ecological perception exists but remains largely utilitarian, revealing that deeper ecological literacy is still developing. Cultural belief systems continue to coexist with scientific awareness, implying that knowledge transformation must be culturally sensitive rather than prescriptive. First-aid responses further reveal that medical literacy does not automatically follow conservation awareness, emphasising the need for integrated risk, health, and conservation communication.

While attitudes toward protection are encouraging, conversion of supportive sentiment into sustained community participation will depend on confidence-building, institutional support, knowledge reinforcement, and access to protective resources. Community-level participation is likely to strengthen when individuals feel both empowered and recognised. In essence, the study indicates that coexistence is not an abrupt behavioural turnaround but an evolving process driven by experiential learning, collective social influence, and improved access to credible intervention pathways. Long-term success will require simultaneous strengthening of ecological understanding, biomedical safety knowledge, and community-anchored conservation leadership, ensuring that behavioural gains translate into durable coexistence practices in similar human–wildlife interaction landscapes.

References

Afroz, A., Hossain, M. S., Rahman, M. A., Rahman, M. R., Rahman, M. M., & Rahman, M. M. (2023). Assessing knowledge and awareness regarding snakebite and its management among healthcare workers and the general population: A systematic review and meta-analysis. *PLOS Neglected Tropical Diseases, 17*(5), e0011048. https://doi.org/10.1371/journal.pntd.0011048

Basak, S. M., Rostovskaya, E., Birks, J., & Wierzbowska, I. A. (2023). Perceptions and attitudes to understand human–wildlife conflict in an urban landscape: A systematic review. *Ecological Indicators, 151*, 110319. https://doi.org/10.1016/j.ecolind.2023.110319

Bateman, H. L., Brown, J. A., Larson, K. L., Andrade, R., & Hughes, B. (2021). Unwanted residential wildlife: Evaluating social–ecological patterns for snake removals. *Global Ecology and Conservation, 27*, e01601. https://doi.org/10.1016/j.gecco.2021.e01601

Das, I. (2002). *A photographic guide to snakes and other reptiles of India*. New Holland Publishers.

Das, S., Banerjee, S., Naskar, S., & Das, D. K. (2021). Care-seeking behaviour of suspected snakebite cases admitted in a medical college of West Bengal: A pathway analysis. *Medical Journal Armed Forces India, 77*(Suppl 1), S58–S62. https://doi.org/10.1016/j.mjafi.2019.11.003

Jayathilaka, I., & Weeratunga, E. (2024). Knowledge in identifying venomous snakes and first aid methods of snakebites among nursing students: A cross-sectional study. *PLOS ONE, 19*(4), e0299814. https://doi.org/10.1371/journal.pone.0299814

Kontsiotis, V. J., Bousbouras, D., Avramidis, P., Kati, V., & Karelia, G. (2022). Public attitudes towards venomous and non-venomous snakes: Implications for biodiversity conservation. *Science of the Total Environment, 845*, 157248. https://doi.org/10.1016/j.scitotenv.2022.157248

Longbottom, J., Shearer, F. M., Devine, M., Alcoba, G., Chappuis, F., Weiss, D. J., Ray, S. E., Ray, N., & Hay, S. I. (2018). Vulnerability to snakebite envenoming: A global mapping of hotspots. *PLOS Neglected Tropical Diseases, 12*(4), e0006450. https://doi.org/10.1371/journal.pntd.0006450

Mohapatra, B., Warrell, D. A., Suraweera, W., & Jha, P. (2011). Mortality from snakebite in India: A nationally representative mortality survey. *PLOS Neglected Tropical Diseases, 5*(4), e1018. https://doi.org/10.1371/journal.pntd.0001018

Newing, H. (2011). *Conducting research in conservation: A social science perspective*. Routledge.

Sinha, S., Udayar, E. S., Narasimha, B. C., Madeshan, A., & Marella, K. (2023). Perceptions and awareness of snakebite envenoming in hilly areas of Madikeri: A cross-sectional study. *MRIMS Journal of Health Sciences, 11*(3), 1–6. https://doi.org/10.4103/mjhs.mjhs_149_22

Suraweera, W., Warrell, D. A., Whitaker, R., Menon, G., Rodrigues, R., Fu, S. H., Begum, R., Sati, P., & Jha, P. (2020). Trends in snakebite deaths in India from 2000 to 2019 in a nationally representative mortality study. *eLife, 9*, e54076. https://doi.org/10.7554/eLife.54076

Vaughn, A. K., Larson, L. R., Peterson, M. N., & Pacifici, L. B. (2022). Factors associated with human tolerance of snakes in the southeastern United States. *Frontiers in Conservation Science, 3*, 1016514. https://doi.org/10.3389/fcosc.2022.1016514

Whitaker, R., & Captain, A. (2004). *Snakes of India: The field guide*. Draco Books.

World Health Organization. (2017). *Snakebite envenoming: A strategy for prevention and control*. World Health Organization.