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Cover: A digital art of water birds of Noyyal River and its wetlands in Coimbatore District by Megha A. Kashyap.

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ARTICLE

Insights into human-wildlife interactions and community views on mangrove restoration in Kendrapada District, Odisha, India

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Abstract: This paper evaluates interactions between humans, Wild Boars, and crocodiles in mangrove ecosystems of the villages of Benakanda, Bhateni, and South Jambu in Mahakalapada Block in the Kendrapada District of the Indian state of Odisha, using questionnaire surveys. This is an area where mangrove restoration is currently in progress. Using a targeted sampling procedure, 280 respondents representing 14% of the population participated in the study. The results show that negative perceptions differ throughout villages, with a majority of respondents reporting interaction between humans and animals in Bhateni (91%) and South Jambu (98%). The most frequent animal reported to cause harm to crop and livelihoods is Wild Boar (44%). Communities understand the value of mangrove restoration despite facing obstacles brought on by interactions with wildlife. The vast majority of residents (87%) believe that restoration efforts were necessary, and many had taken part in these by themselves, or in conjunction with other communities.

Keywords: Crops, livelihoods, livestock, local communities, people perception, Saltwater Crocodile, Wild Boar.

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Author contributions: Study conception and design: Vijai Dharmamony, Muralidharan Manoharakrishnan, Janmejay Sethy and Murali Krishna Chatakonda, Data collection: Mohd Qayyum and Sadhwi Sindura, Analysis and interpretation of results: Vijai Dharmamony, Muralidharan Manoharakrishnan, Janmejay Sethy and Mohd Qayyum Draft manuscript preparation: Muralidharan Manoharakrishnan, Janmejay Sethy, Mohd Qayyum and Murali Krishna Chatakonda. All authors reviewed the manuscript and approved the final version of the manuscript.

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INTRODUCTION

Mangrove forests are unique ecosystems in tropical and subtropical coastal regions that contain salt-tolerant trees, shrubs and other vegetation. They help maintain coastal biodiversity and contribute to the planet's overall health. Mangroves are found in 118 countries and are distributed across southern & southeastern Asia, Africa, America, and Oceania. In India, 4,660 km^2 of diverse mangrove forests make up 0.14% of the country's total land area (Ragavan et al. 2019; Bryan-Brown 2020). These forests are concentrated in river deltas, estuaries, and sheltered coastal areas, where freshwater and tidal inflow create ideal conditions for mangrove growth. The forests provide essential resources for neighbouring communities, including food, fuel, medicine, and other traditional goods.

Indian mangroves have experienced significant loss, with a declining trend since 1995 (Kathiresan 2018). Previously viewed as wastelands, they are now protected for their ecological and environmental value (Badola & Hussain 2005; Hussain & Badola 2010). The "Green India Mission" and the National Action Plan on Climate Change (2008) prioritized mangrove conservation and restoration (MoEF&CC 2009). Human-wildlife interactions (HWI) have been considered one of the most challenging issues of wildlife conservation in the world (Holmern et al. 2007; Acharya et al. 2017; Bhatia et al. 2020; Stoldt et al. 2020; Zhang et al. 2020; Halley et al. 2021). Negative interactions between humans and wildlife arise with human expansion and intrusion into natural habitats (Nyhus & Tilson 2004; Graham et al. 2005), from the implementation of nature protection measures, and the rise of wild animal populations (Fall & Jackson 1998; Palmeira et al. 2008). Globally, there seems to be a rise in conflicts between agricultural interests and the preservation of wildlife (Redpath et al. 2013; Madden & McQuinn 2014).

Human activities gradually destroy the natural habitat of wildlife, which increases human-wildlife interactions globally (Nyhus 2005; Agarwal et al. 2016; Digun-Aweto et al. 2022). Economic losses impact livelihoods, leading to poverty, food insecurity, and conflicts between farmers and environmentalists, potentially causing the retaliatory killing of wild species (Katel et al. 2014). Human-wildlife interaction in India is a pressing issue, as the growing human population and habitat encroachment increasingly lead to negative interactions between people and wildlife, jeopardizing both human livelihoods and animal conservation efforts. Balancing the needs of local communities and the preservation of India's rich biodiversity is a complex challenge (Datta et al. 2012; Manral et al. 2016). In India, interactions between humans and wildlife, such as with the elephants and tigers, often result in crop damage, property destruction, and occasionally threats to human and animal lives, highlighting the challenges of coexistence and conservation efforts (Conover 2002; Decker et al. 2002; Madden 2004; Dickman 2010). When it comes to mangroves, the studies on human-tiger interactions and human-crocodile interactions are evident in their negativity and often appear in the literature (Vyas & Sengupta 2012; Khan et al. 2020; Dhar & Mandol 2023). Wild Boars can reside in a range of environments, including taigas, tropical forests, mountains, and marshes (Massei et al. 2011; Acevdo et al. 2014). Wild Boars threaten farmer livelihoods through crop depredation which is also aided by their rapid population growth, high fertility, and the absence of predators (Seward et al. 2004; Geisser & Reyer 2005; Liu et al. 2019; Csókás et al. 2020). The roles of natural ecosystems, such as mangroves, and hydrological variables, such as proximity to rivers, as well as various socio-economic factors determining economic well-being, are rarely taken into account (Das 2012). Bhitarkanika National Park is the second largest contiguous mangrove forest in India, with approximately 0.15 million mangrove-dependent populations residing in and around 307 villages within the protected area (Das et al 2022).

This study explores the relationship between mangrove conservation and wildlife interactions and the attitude of the community towards mangrove restoration in our study area, the Kendrapada District in Odisha State.

METHODS

Study Area

The study was conducted in Kendrapara District of the coastal Indian state of Odisha which lies between 20.3333–20.6167 °N and 86.2333–87.0167 °E. Bhateni, Benakanda, and South Jambu are three villages in Kendrapara District where the questionnaire surveys were conducted. Nestled close together, the three villages present a unique region of river and mangrove access. South Jambu is directly connected to the Dabka River and surrounded by lush mangroves. Bhateni is mostly enclosed by mangroves, with only a small area open to the river. In contrast, Benakanda is more exposed to the mangrove area (Figure 1).

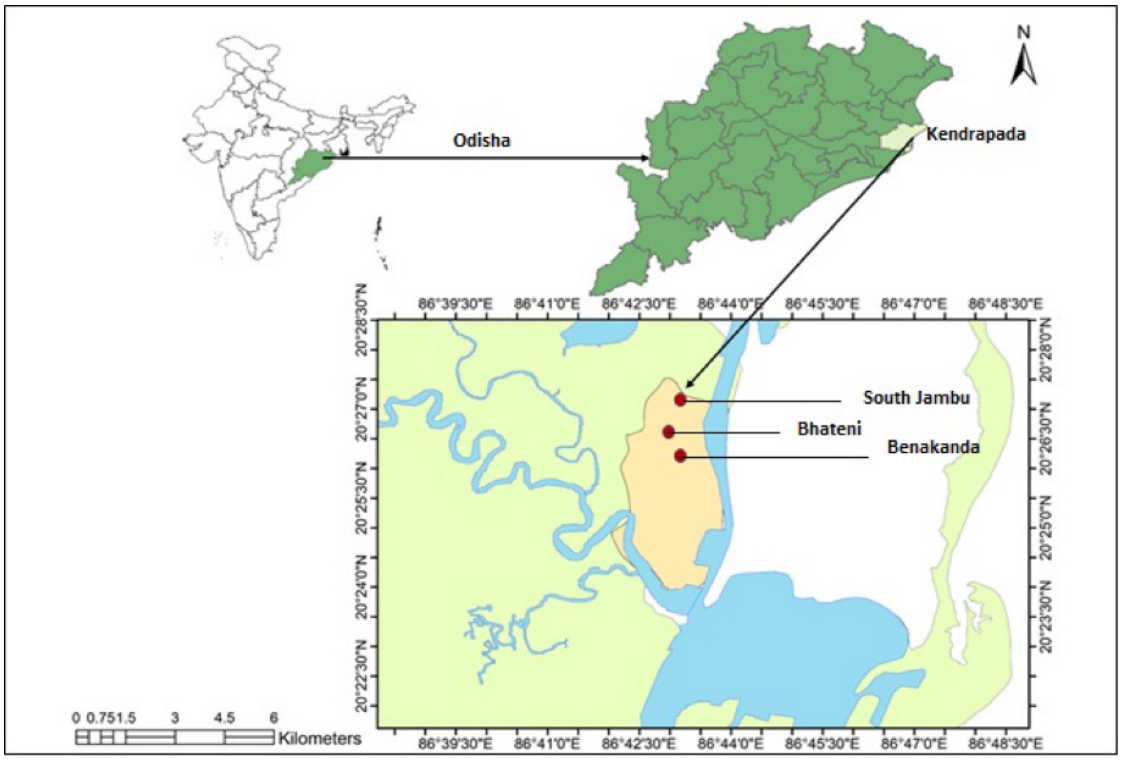

Figure 1. Map of the study area showing South Jambu, Benakanda and Bhateni.

In recent years, severe weather events such as cyclones and floods have increased in the Bhitarkanika landscape region (Kadaverugu et al. 2022). The two major river systems further make it vulnerable to cyclones, storm surges, and floods. The ingress of seawater is another threat that has also displaced many villages and threatened the livelihoods of the people in the landscape. The district has mangrove forests with varying widths of 100–10,000 m in places and narrow patches of Casuarina plantations near the sand dunes, but their presence is very limited (Das 2020).

Questionnaire survey

A survey was carried out in three villages where the mangrove restoration program by WWF India is in progress to gain further insight into the interactions between humans and wildlife in the mangrove forest as well as the opinions of the locals on the preservation of mangroves. In February and March of 2023, the survey was conducted over two months. Before the comprehensive questionnaire survey was carried out, interactive sessions and informal discussions were organised in the villages of Benakanda, Bhateni, and South Jambu. The questionnaire concerning the interaction between human-wildlife and mangrove restoration was developed after the pilot study (Appendix 1).

The interviews aimed to explore people's reliance on the mangrove ecosystem as a source of income as well as to understand the HWI in this region. All respondents freely participated in the questionnaire after providing informed verbal consent. For those participants who were less than 18 years of age, consent was taken from their parents/guardians before the commencement of the questionnaire. Prior to this, the study's purpose and their right to withdraw even in the middle of the interview, were clearly explained. This ensured ethical data collection through voluntary and informed participation. Open-ended questions were asked as they are more advantageous than closed-format questions when trying to understand the attitude of respondents (Newing 2010). We gathered information on which animals were most involved in the interaction (mostly negative) and whether these occurred seasonally. Additionally, we inquired about the types of crops that these animals feed on, the damages they cause, and whether the government provides any compensation or compassionate payment to address these negative interactions and pacify hostility.

We interviewed a total of 280 families, which represents 14% of the targeted population. These families included local representatives, leaders, fishermen, farmers, landowners, and daily wage labourers. The

purpose of the interviews was to determine the significance of mangroves in their lives, the occurrence of interactions between humans and wildlife, and the damages caused during these interactions. We worked with field staff from the forest and wildlife department of the state government, who acted as translators for the interviews conducted in Odia and Bengali. The data was analysed using Microsoft Excel.

RESULTS

The survey shows that 85% of the interviewed people reported experiencing HWI in the area.

Our study observed different gender distribution patterns in the three villages. In Benakanda, approximately 65.56% of the respondents were men. Similarly, in Bhateni, around 62.23% of the respondents were male, and 36.67% were female. In South Jambu, over 67% of the population was male, while females accounted for roughly 32% (Figure 2).

Age classification of the informants

The percentage of respondents was categorised by their generational group—Younger Generation (15–30 years), Mid Generation (31–60 years), and Old Generation (61–90 years)—across the three villages. This data helps in understanding the demographic distribution across these villages. This group constitutes the largest percentage of respondents in each village. South Jambu has the highest proportion at approximately 70%, followed by Benakanda (65%), and Bhateni (60%). The percentage of the younger generation is fairly consistent across the three villages, with each village having around 20% of its respondents in this category (Figure 3).

Species associated with human-wildlife interaction (Overall account)

Wild Boars were reported to account for the majority (43.6%) of interaction cases (where the crop is damaged), followed by jackals (21.3%), Saltwater Crocodiles (12.8%) (poultry and livestock lifting), and the remaining (22.3%) were comprised of wild cats, Spotted Deer, langurs, snakes, and birds. In Benakanda the maximum cases were observed with Wild Boars (49.39%), followed by Rhesus Macaques (22.22%), and crocodiles (12.36%), while jackals and wild cats accounted for less (4.94%) of interactions (Figure 4). Whereas in South Jambu it was maximum with Wild Boars (51.85%), followed by jackals (16.05%), Rhesus Macaques (14.20%), and crocodiles (10.49%). In Bhateni, the maximum number of cases were of jackals (38.56%), followed by Wild Boars (24.84%), wild cats (16.99%), and crocodiles (13.08%). Based on the respondents we observed varying human-wildlife interactions in different areas of the study site (Image 1,2).

Seasonal variation

The majority of interactions were reported during the cropping season, which runs from June to December. The areas with the highest reported interactions were Benakanda (71.11%), followed by Bhateni (61.2%), and South Jambu (59%). Wild Boars are the main cause of damage to paddy and tuber crops during this time, and they also pose a risk of injuries to humans (Figure 5). This issue is particularly prominent in South Jambu and Benakanda. In contrast, the risk of interactions remains consistent throughout Bhateni, as a large area of the village borders the mangrove forest. During the non-cropping season, the highest number of cases were reported in South Jambu (41%), followed by Bhateni (38.8%), and Benakanda (28.89%) (Figure 5).

Damage caused

The percentage of crop damage is highest in South Jambu at 48.0%, followed by Benakanda at 28% and Bhateni at 24%. In Benakanda, 36% of the population suffered injuries. In Bhateni, 53% of the cattle have been lost, which is higher compared to the other two villages (Figure 6). The “No loss” category represents the proportion of the population or property that has not suffered any loss. In South Jambu, 16% of the population or property hasn’t experienced any loss due to human-wildlife interactions. These give insights into the impact of certain factors on each village’s agriculture, population, and livestock. It helps in understanding the vulnerability and resilience of each community in the face of these challenges.

Human-wildlife interactions were claimed by the villagers for crop damage, livestock losses, and injuries. The most agricultural damage was observed in South Jambu, the area closest to the mangroves. The greatest number of livestock losses (cattle and goat) were reported in Bhateni, a region with vast fields that are home to Jackals and wild cats. Most injuries were reported in South Jambu and Benakanda (Image 2).

Mangrove restoration

In both the individual and community categories, Bhateni and Benakanda show higher percentages of restoration compared to South Jambu. South Jambu has the highest percentage in the “Restoring with

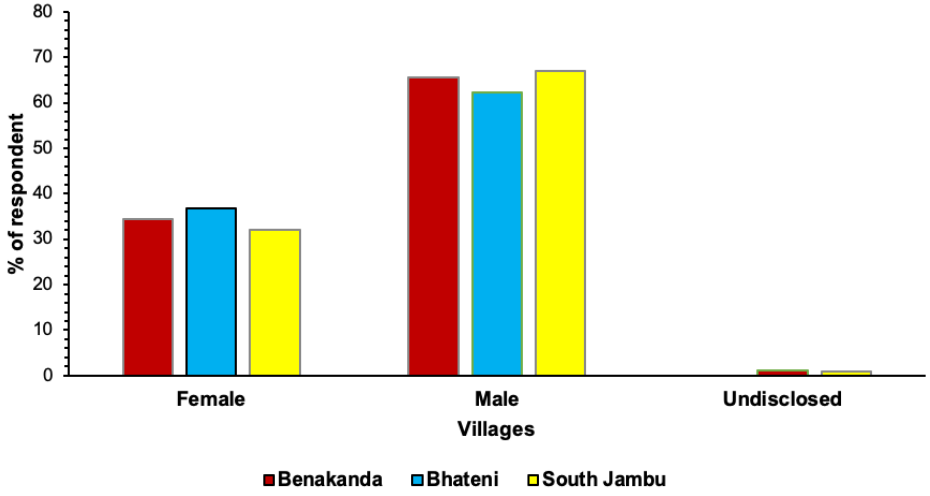

Figure 2. Gender-wise respondents in different villages.

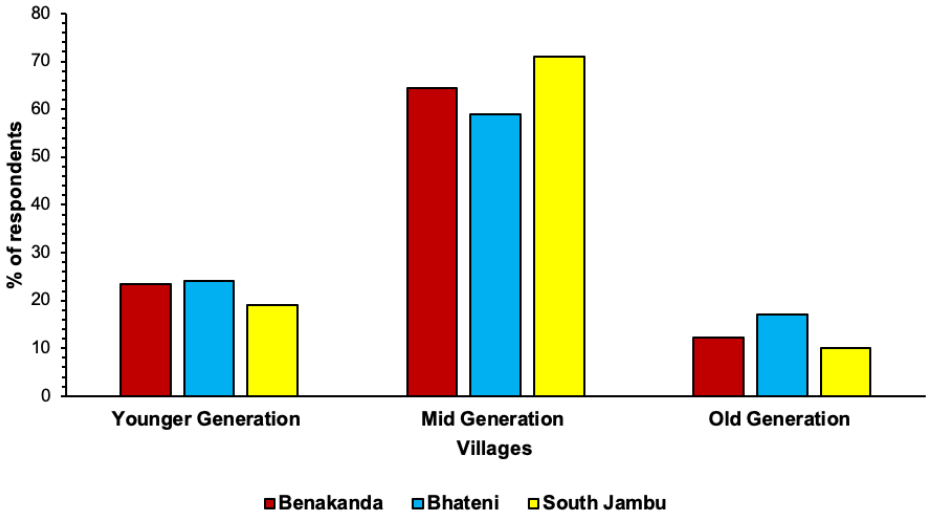

Figure 3. Age-wise respondents in different villages.

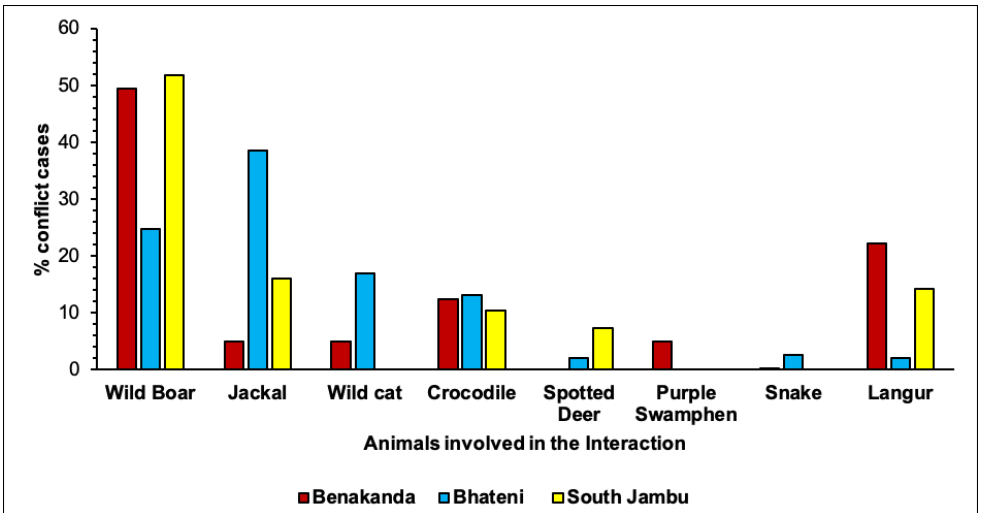

Figure 4. Different animals cause interactions in the respective villages.

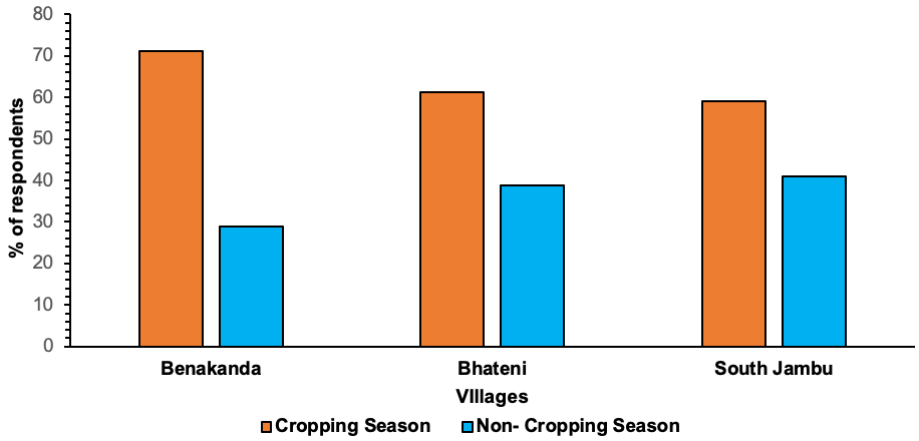

Figure 5. Season-wise human-wildlife interaction in the study area.

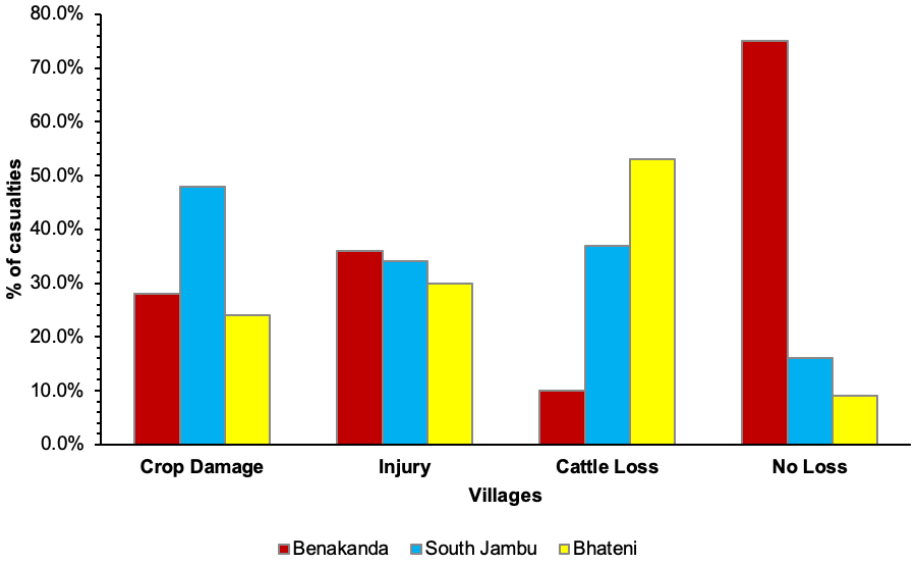

Figure 6. Human-wildlife interaction patterns in different villages.

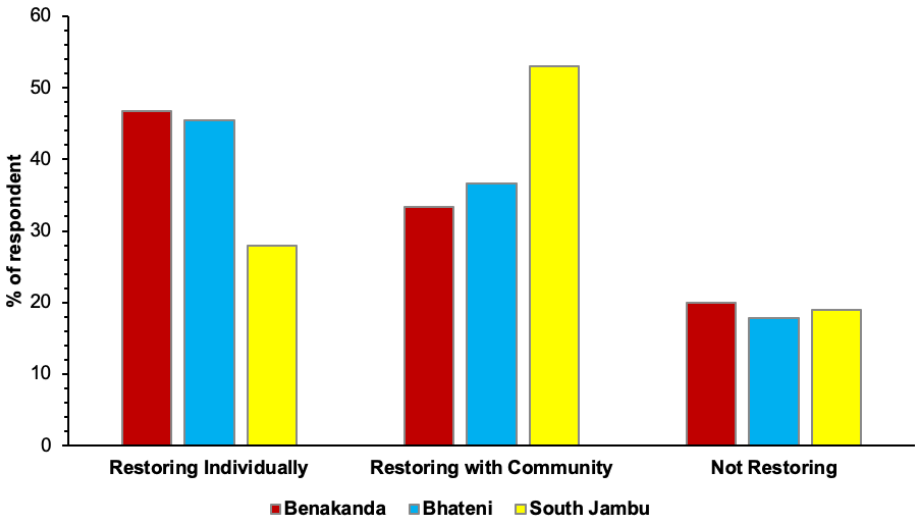

Figure 7. Restoration perception of local communities in different villages.

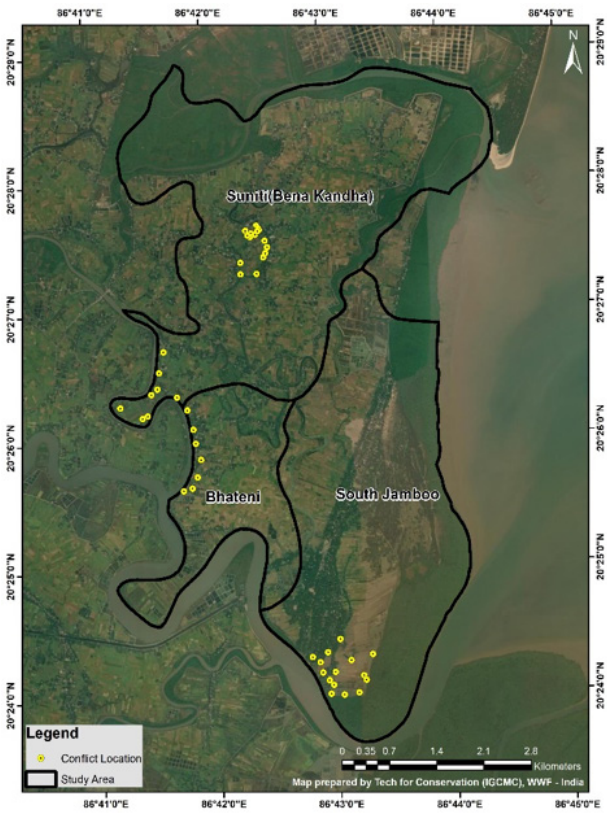

Image 1. Human-wildlife interaction locations.

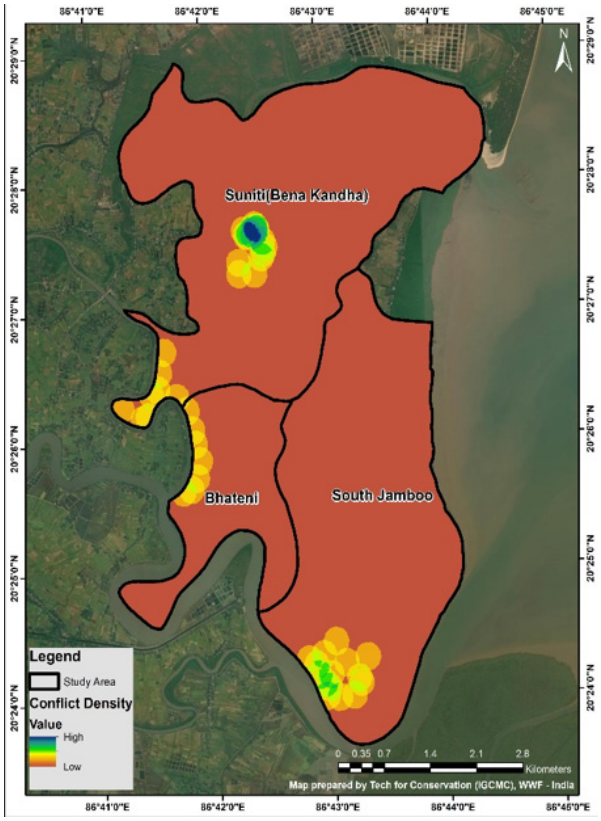

Image 2. Human-wildlife interaction density.

Community" category, indicating that community efforts are more prevalent there compared to individual initiatives. Bhateni and Benakanda seem to have a more balanced approach to individual and community-based restoration than South Jambu. For individual restoration, the percentages are Benakanda (46.67%), Bhateni (45.5%), and South Jambu (28%). In South Jambu, 53% of the community supports the restoration of mangroves. In Bhateni and Benakanda, the percentages are 36.66% and 33.33%, respectively. The majority of villagers agree that mangrove restoration is essential. However, while some prefer to work alone, others prefer to involve the community in the restoration work. Some remaining residents have shown no interest in restoring mangroves due to fears of potential HWI (Figure 7).

Awareness of Government schemes

Knowledge and awareness of government schemes related to HWI and compensation or compassionate grants provided in case of injury or damage were also assessed. The majority of respondents (92%) were unaware of any government schemes in their area, while only a small percentage (1.2%) had little knowledge, and a few (6.8%) had no idea about any government schemes (Figure 8).

DISCUSSION

This study provides information on human-wildlife interactions in the study area involving primarily crocodiles, wild cats, and Wild Boar. A majority of those interviewed emphasized the importance of human-boar interactions. Our research evaluated instances of interactions between humans and wildlife species such as Wild Boars in the mangrove ecosystem. These interactions likely arose due to habitat loss, competition for resources, and potential threats to livelihoods. This negative interaction is consistent with global observations (Mathur et al. 2015), which attest to the widespread appreciation of Wild Boar crop predators (Tisdell 1980; Bengsen et al. 2014). This negative interaction reflects their behavioural plasticity and increasing dependency on agricultural produce (Herrero et al. 2003).

Wild Boars were reported as being responsible for negative interactions in all villages. These interactions occur mostly during the cropping season when the boars feed on paddy fields and tuber crops during the

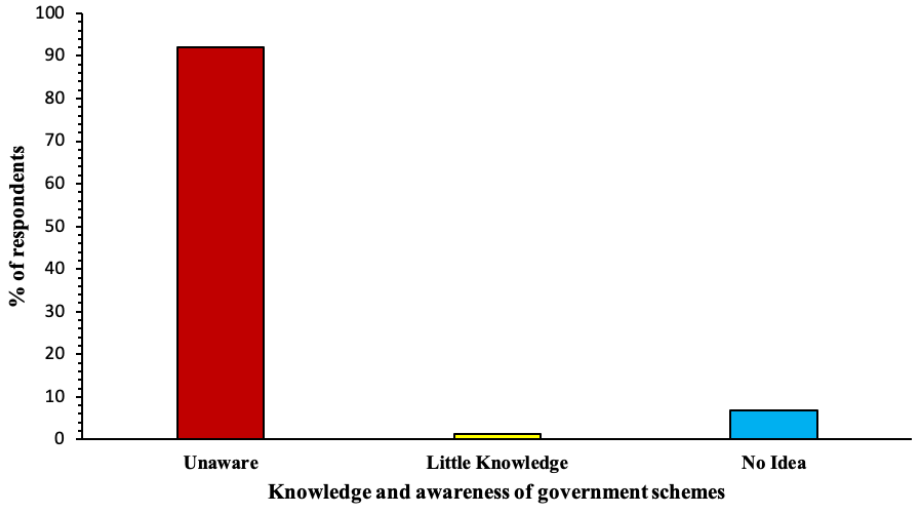

Figure 8. Knowledge and awareness of government schemes for human-wildlife interaction.

off-season. They are reported to come in large groups at night to eat the crops, and sometimes even sleep in the agricultural fields. When the farmers check on their crops, the boars cause injuries to anyone in their path while trying to escape from the farmers. Fencing done by the government, and the lack of fencing in some areas, increase the chances for animals to cause harm. Additionally, venturing into the forest in search of fodder and firewood puts people at risk of encountering animals. Unlike the majority of other wildlife, rising anthropogenic pressure has offered Wild Boars opportunities to expand their populations. Accordingly, the circumstances for interactions also increased in human-wildlife interface areas (Milda et al. 2023).

Wild Boars threaten farmers' livelihoods through crop depredation, which is aided by rapid boar population growth, high fecundity, and the absence of predators (Seward et al. 2004; Geisser & Reyer 2005; Liu et al. 2019; Csókás et al. 2020). Their entry into homes can be dangerous and has resulted in injuries and even loss of life. To protect themselves, farmers resort to various measures, such as building fences around their fields and homes. However, these measures are not always effective in stopping Wild Boars.

In previous seasons, farmers have also focused more on growing flowers than vegetables. A study conducted by Chauhan et al. (2009) advised changing crop patterns near forests by planting different income-generating crops instead of highly vulnerable crops. To resolve the interactions between people and Wild Boars, they experimented with traditional methods, such as using human hair to deter Wild Boars. However, this proved ineffective after a few days as the Wild Boars became accustomed. Similar techniques were observed by Rao et al. (2008) who found that many farmers in the Telangana State were using such farming strategies and development pathways of small-holder farming systems namely, (i) crop without livestock (CWL), (ii) crop with small ruminants (CSR), and (iii) crop with dairy (CD), in the context of climate change to reduce the damage caused by Wild Boars by 40–50 %. This study revealed that while many strategies have been attempted to address the interactions, they do not last long as they become ineffective after a few days.

The impact of Wild Boars on the livelihoods of people in rural areas is evident also in a study conducted in China, where on average, each household experienced a loss of 10,480 RMB (the Chinese renminbi) per year (Wang et al. 2023). While Wild Boars have been destroying crops and causing physical harm, jackals and wild cats have been causing a loss to cattle and poultry, despite fencing. Khan et al. (2020) report the long tradition of crocodile-human interactions. Crocodiles are associated with deities in several local communities across the nation. However, Project Crocodile's restoration attempts have been thwarted by increasing human encroachment and intolerance of crocodiles, mostly resulting in a reduction in crocodile habitat (Das & Jana 2018). This has led to a decline in the amount of available habitat for crocodiles leading to conflicts (Khan et al. 2020). This study did not report saltwater crocodiles causing any casualty of life in the region. However, the fishermen and villagers living near the forest often mentioned that they must be careful all the time because of the crocodile presence in the area and their entry into the fishponds, cattle sheds, and poultry, predating on fish and livestock like hens,

ducks, and rarely cattle. Fencing around their houses and ponds has given them a positive result.

It was observed that the local community holds mangroves with great reverence as they consider the mangrove trees as sacred trees. Furthermore, they are appreciative of the benefits of fodder, fuelwood, fruits and fish provided by the mangrove habitats. The community is closely connected to the mangroves and actively participates in their restoration by planting more trees in the vicinity of their homes and within the community. This has resulted in a low rate of exploitation in the area. The community receives various services from the mangroves such as firewood, crabs, and fishes (provisioning services), climate change regulation (regulating services), and protection from soil erosion (supporting services). Villagers lack the information on schemes available to them when damage is caused due to HWI. This knowledge gap hinders their ability to seek government assistance. However, there's a positive side: the majority of villagers recognize the importance of mangroves and are enthusiastic about their restoration. With proper guidance from the government or NGOs, they can play a crucial role in protecting these vital ecosystems, rather than contributing to their destruction. WWF-India has also initiated a conservation initiative on a plot of land in collaboration with the community, where they have established a nursery (employing local people) and are raising mangrove species to restore 22 ha of lost mangroves in community land alongside the Gobari River, spread across the three selected villages. On average, these resources contribute to over 14.5% of households' total income, with this proportion rising to over 30% for poorer households living near the forests (Badola & Hussain 2003). Given that these households typically have lower levels of education, employment, and income, their reliance on the mangrove resources is even greater.

Thus, the current study provides necessary base information for planning future restoration programs and investigating aspects that might cause hindrances. `

REFERENCES

Acevedo, P., F. Quirós-Fernández, J. Casal & J. Vicente (2014). Spatial distribution of wild boar population abundance: Basic information for spatial epidemiology and wildlife management. *Ecological Indicators* 36: 594–600. https://doi.org/10.1016/j.ecolind.2013.09.019

Acharya, K.P., P.K. Paudel, S.R. Jnawali, P.R. Neupane & M. Koehl (2017). Can forest fragmentation and configuration work as indicators of human-wildlife conflict? Evidence from human death and injury by wildlife attacks in Nepal. *Ecological Indicators* 80: 74–83. https://doi.org/10.1016/j.ecolind.2017.04.037

Agrawal, P.K., A. Verghese, S.R. Krishna & K. Subaharan (2016). Human-animal conflict in agro-pastoral context: issues & policies. Indian Council of Agricultural Research, New Delhi, India, 56 pp.

Badola, R. & S.A. Hussain (2003). Conflict in paradise. *Mountain Research and Development* 23(3): 234–237. https://doi.org/10.1659/0276-4741(2003)023[0234:CIP]2.0.CO;2

Badola, R. & S.A. Hussain (2005). Valuing ecosystem functions: an empirical study on the storm protection function of Bhitarkanika mangrove ecosystem, India. *Environmental Conservation* 32(1): 85–92. https://doi.org/10.1017/S0376892905001967

Bengsen, A.J., M.N. Gentle, J.L. Mitchell, H.E. Pearson & G.R. Saunders (2014). Impacts and management of wild pigs *Sus scrofa* in Australia. *Mammal Review* 44(2): 135–147. https://doi.org/10.1111/mam.12011

Bhatia, S., S.M. Redpath, K. Suryawanshi & C. Mishra (2020). Beyond conflict: exploring the spectrum of human-wildlife interactions and their underlying mechanisms. *Oryx* 54(5): 621–628. https://doi.org/10.1017/S003060531800159X

Bryan-Brown, D.N., R.M. Connolly, D.R. Richards, F. Adame, D.A. Friess & C.J. Brown (2020). Global trends in mangrove forest fragmentation. *Scientific Reports* 10(1): 7117. https://doi.org/10.1038/s41598-020-63880-1

Chauhan, N.P.S., K.S. Barwal & D. Kumar (2009). Human–wild pig conflict in selected states in India and mitigation strategies. *Acta Silvatica et Lignaria Hungarica* 5: 189–197.

Conover, M.R. (2002). *Resolving Human-Wildlife Conflicts: The Science of Wildlife Damage Management*. CRC Press, 440 pp. https://doi.org/10.1201/9781420032581

Csókás, A., G. Schally, L. Szabó, S. Csányi, F. Kovács & M. Heltai (2020). Space use of wild boar (*Sus Scrofa*) in Budapest: are they resident or transient city dwellers? *Biologia Futura* 71(1–2): 39–51. https://doi.org/10.1007/s42977-020-00010-y

Das, S. (2012). The role of natural ecosystems and socio-economic factors in the vulnerability of coastal villages to cyclone and storm surge. *Natural Hazards* 64(1): 531–546. https://doi.org/10.1007/s11069-012-0255-9

Das, S. (2020). Evaluation of mangrove ecosystem services: methodological and data challenges, pp. 157–174. In: Gupta, A., Dalei, N. (eds.). *Energy, Environment and Globalization*. Springer, Singapore, 306 pp. https://doi.org/10.1007/978-981-13-9310-5_9

Das, C.S. & R. Jana (2018). Human–crocodile conflict in the Indian Sundarban: an analysis of spatio-temporal incidences in relation to people's livelihood. *Oryx* 52(4): 661–668. https://doi.org/10.1017/S0030605316001502

Das, S.K., B. Das, A.B. Jena, C. Pradhan, G. Sahoo & J. Dandapat (2022). Therapeutic Potential and Ethnopharmacology of Dominant Mangroves of Bhitarkanika National Park, Odisha, India. *Chemistry & Biodiversity* 19(3): e202100857. https://doi.org/10.1002/cbdv.202100857

Datta, D., R.N. Chattopadhyay & P. Guha (2012). Community-based mangrove management: A review on status and sustainability. *Journal of Environmental Management* 107: 84–95. https://doi.org/10.1016/j.jenvman.2012.04.013

Decker, D.J., T.B. Laube & W.F. Siemer (2002). Human-wildlife conflict management. A Practitioner's Guide Northeastern Wildlife Damage Management Research and Outreach Cooperative. Human Dimensions Research Unit Cornell University, Ithaca, New York, 48 pp.

Dhar, S.B. & S. Mondal (2023). Nature of Human-Tiger Conflict in Indian Sundarban. *Trees, Forests and People* 12: 100401. https://doi.org/10.1016/j.tfp.2023.100401

Dickman, A.J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal Conservation* 13(5): 458–466. https://doi.org/10.1111/j.1469-1795.2010.00368.x

Digun-Aweto, O., P. Van Der Merwe & M. Saayman (2022). Tolerance factors in human-wildlife conflicts in protected areas: the case of Cross River National Park, Cross River State Nigeria. *GeoJournal* 87(1): 349–361. https://doi.org/10.1007/s10708- 020-10254-9

Fall, M.W. & W.B. Jackson (1998). A new era of vertebrate pest control? an introduction special issue. *International Biodeterioration and Biodegradation* 42: 85–91.

Geisser, H. & H.U. Reyer (2005). The influence of food and temperature on population density of wild boar *Sus scrofa* in the Thurgau (Switzerland*). Journal of Zoology* 267(1): 89–96. https://doi.org/10.1017/S095283690500734X

Graham, K., A.P. Beckerman & S. Thirgood (2005). Human–predator-prey conflicts: ecological correlates, prey losses and patterns of management. *Biological Conservation* 122(2): 159–171. https://doi.org/10.1016/j.biocon.2004.06.006

Halley, D.J., A.P. Saveljev & F. Rosell (2021). Population and distribution of beavers Castor fibre and Castor canadensis in Eurasia. *Mammal Review* 51(1): 1–24. https://doi.org/10.1111/mam.12216

Herrero, J. & D.F. De Luco (2003). Wild boars (*Sus scrofa* L.) in Uruguay: scavengers or predators?. *Mammalia* 67(4): 485–492. https://doi.org/10.1515/mamm-2003-0402

Holmern, T., J. Nyahongo & E. Røskaft (2007). Livestock loss caused by predators outside the Serengeti National Park, Tanzania. *Biological Conservation* 135(4): 518–526. https://doi.org/10.1016/j.biocon.2006.10.049

Hussain, S.A. & R. Badola (2010). Valuing mangrove benefits: contribution of mangrove forests to local livelihoods in Bhitarkanika Conservation Area, East Coast of India. *Wetlands Ecology and Management* 18: 321–331. https://doi.org/10.1007/s11273-009-9173-3

Kadaverugu, R., S. Dhyani, V. Purohit, R. Dasgupta, P. Kumar, S. Hashimoto, P. Pujari & R. Biniwale (2022). Scenario-based quantification of land-use changes and its impacts on ecosystem services: A case of Bhitarkanika mangrove area, Odisha, India. *Journal of Coastal Conservation* 26(4): 26–30. https://doi.org/10.1007/s11852-022-00877-0

Katel, O.N., S. Pradhan & D. Schmidt-Vogt (2014). A survey of livestock losses caused by Asiatic wild dogs, leopards and tigers, and of the impact of predation on the livelihood of farmers in Bhutan. *Wildlife Research* 41(4): 300–310. https://doi.org/10.1071/WR14013

Kathiresan, K. (2018). Mangrove forests of India. *Current Science* 114(5): 976–981. https://doi.org/10.18520/cs%2Fv114%2Fi05%2F976-981

Khan, W., U. Hore, S. Mukherjee & G. Mallapur (2020). Human-crocodile conflict and attitude of local communities toward crocodile conservation in Bhitarkanika Wildlife Sanctuary, Odisha, India. *Marine Policy* 121: 104135. https://doi.org/10.1016/j.marpol.2020.104135

Liu, L., Z. Ren, Q. Wang, S. Ge, Y. Liu, C. Liu, F. Liu, Y. Hu, Li., J. Bao & Z. Wang (2019). Infection of African swine fever in wild boar, China, 2018. *Transboundary and Emerging Diseases* 66(3): 1395–1398. https://doi.org/10.1111/tbed.13114

Madden, F. (2004). Creating coexistence between humans and wildlife: global perspectives on local efforts to address human-wildlife conflict. *Human Dimensions of Wildlife* 9(4): 247–257. https://doi.org/10.1080/10871200490505675

Madden, F. & B. McQuinn (2014). Conservation's blind spot: The case for conflict transformation in wildlife conservation. *Biological Conservation* 178: 97–106. https://doi.org/10.1016/j.biocon.2014.07.015

Manral, U., S. Sengupta, S.A. Hussain, S. Rana & R. Badola (2016). Human-wildlife conflict in India: a review of the economic implication of loss and preventive measures. *Indian Forester* 142(10): 928–940. https://doi.org/10.36808/if%2F2016%2Fv142i10%2F93647

Massei, G. & D. Cowan (2011). Fertility control to mitigate human-wildlife conflicts: a review. *Wildlife Research* 41(1): 1–21. https://doi.org/10.1071/WR13141

Mathur, V.B., S.S. Bist, M. Kaushik, N.A. Mungi & Q. Qureshi (2015). Management of human-wildlife interaction and invasive species in India. Report number (TR-2015/004), Wildlife Institute of India, Dehradun, 236 pp.

Milda, D., T. Ramesh, R. Kalle, V. Gayathri, M. Thanikodi & K. Ashish (2023). Factors driving human–wild pig interactions: implications for wildlife conflict management in southern parts of India. *Biological Invasions* 25(1): 221–235.

MoEF&CC (2009). Climate change and India: towards the preparation of a comprehensive climate change assessment. Ministry of Environment & Forests, Government of India, 24 pp.

Newing, H. (2010). *Conducting Research in Conservation: Social Science Methods and Practice*. Routledge. 1st Edition, 400 pp. https://doi.org/10.4324/9780203846452

Nyhus, P.J. (2005). *7 Bearing the costs of human-wildlife conflict: the challenges of compensation schemes Philip J. Nyhus, Steven A. Osofsky, Paul Ferraro, Francine Madden and Hank Fischer*. *People and Wildlife, Conflict or Co-existence*. Cambridge University Press 9: 107–121. https://doi.org/10.1017/CBO9780511614774.008

Nyhus, P. & R. Tilson (2004). Agroforestry, elephants, and tigers: balancing conservation theory and practice in human-dominated landscapes of Southeast Asia. *Agriculture, Ecosystems & Environment* 104(1): 87–97. https://doi.org/10.1016/j.agee.2004.01.009

Palmeira, F.B.L, P.G. Crawshaw Jr, C.M. Haddad, K.P.M.B. Ferraz & L.M. Verdade (2008). Cattle depredation by puma (*Puma concolor*) and jaguar (Panthera onca) in central-western Brazil. *Biological Conservation* 141(1): 118–125. https://doi.org/10.1016/j.biocon.2007.09.015

Ragavan, P., S.K. Dubey, J.C. Dagar, P.M. Mohan, K. Ravichandran, R.S.C. Jayaraj & T.S. Rana (2019). Current Understanding of the Mangrove Forests of India. In: Dagar, J., R. Yadav & P. Sharma (eds.). Research Developments in Saline Agriculture. Springer, Singapore. https://doi.org/10.1007/978-981-13-5832-6_8

Redpath, S.M., J. Young, A. Evely, W.M. Adams, W.J. Sutherland & R.J. Gutierrez (2013). Understanding and managing conservation conflicts. *Trends in Ecology & Evolution* 28(2): 100–109. https://doi.org/10.1016/j.tree.2012.08.021

Stoldt, M., T. Göttert, C. Mann & U. Zeller (2020). Transfrontier conservation areas and human-wildlife conflict: The case of the Namibian component of the Kavango-Zambezi (KAZA) TFCA. *Scientific Reports* 10(1): 7964. https://doi.org/10.1038/s41598-020-64537-9

Seward, N.W., K.C. VerCauteren, G.W. Witmer & R.M. Engeman (2004). Feral swine impacts on agriculture and the environment. *Sheep and Goat Research Journal* 19: 34–40.

Tisdell, C.A. (1980). Wild Pigs: Environmental Pest or Economic Resource? Pergamon Press, New York, NY, USA. https://doi.org/10.1016/B978-0-08-024821-9.50001-9

Vyas, P. & K. Sengupta (2012). Mangrove conservation and restoration in the Indian Sundarbans. Sharing lessons on mangrove restoration, 93 pp.

Wang, C.C., B.X. Zeng, X.Q. Song, D.S. Luo & T.T. Lin (2023). Impacts of wild boars on local livelihoods in rural communities: A case study of mountainous areas in southeast China. *Frontiers in Environmental Science* 11: 1048808. https://doi.org/10.3389/fenvs.2023.1048808

Zhang, S., W. Deng, L. Peng, P. Zhou & Y. Liu (2020). Has rural migration weakened agricultural cultivation? evidence from the mountains of Southwest China. *Agriculture* 10(3): 63. https://doi.org/10.3390/agriculture10030063

Appendix 1. Questionnaire survey format for human-wildlife interaction.

CONTACT DETAILS

Name: **Age:**

Address: **Education:**

Gender: **Members:**

Sno	Questions
1.	What are ecosystem services that mangrove provides?
2.	Does the mangrove ecosystem provide a source of fresh water to you?
3.	Is there any noticeable change in the quality of water during the hightide and low tide?
4.	Do the mangroves have any cultural importance/ Values/ Purpose due to its natural character and traditional uses?
5.	Are there any traditional practices done by the community to conserve/protect the mangroves?
6.	Is mangrove ecosystem can provide sufficient income to support the family
7.	Does the community invite other parties to plant mangroves around the coastal area?
8.	Which animal appears the most often in Human-Wildlife interaction? What do you do to mitigate it?
9.	Do they have any particular season?
10.	Are there any particular crops they feed on?
11.	Types of Damages caused by them? (Economic Damage, Loss of Life, Injury)
12.	Does the government provide any compensation policy to mitigate the Human-Wildlife interaction?
13.	How can you describe your relationship with the animal?

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