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A novel assessment of nylon barriers against tiger incursions of Sundarban Tiger Reserve area

[1]Anik Biswas, [2]Jones Justin, [2]Sankar Sekhar Biswas, [3]A Goswami and [3]Sukanta Biswas

[1]Department of Wildlife Science, University of Kota, Rajasthan, India

[2]Sundarban Tiger Reserve, West Bengal, India

[3]Department of Veterinary & A.H. Extension Education, WBUAFS, Kolkata, West Bengal, India

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Corresponding Author: Anik Biswas

Abstract

Human–wildlife conflict remains one of the most critical conservation challenges in the Sundarban Tiger Reserve, where dense human settlements coexist with large carnivores and other wildlife within a fragile estuarine ecosystem. This study evaluates the effectiveness of nylon net fencing as a long-term mitigation strategy for reducing wildlife incursions and associated socio-economic losses. A mixed-method approach was adopted, combining structured questionnaire surveys across 40 conflict-prone JFMCs (n=1040 respondents) and Forest Department (n=32), semi-structured interviews with forest officials and local stakeholders and analysis of secondary conflict records maintained by the Forest Department. Spatial mapping using GIS and statistical analyses, including chi-square tests, Mann–Whitney U tests and correlation analysis, was employed to assess relationships between fence installation, maintenance, community participation, and conflict outcomes. Results indicate a substantial decline in wildlife intrusions following fence installation, with a nearly 98% reduction in tiger incursions over the past five years in several high-risk villages. Households protected by well-maintained fences reported significantly lower conflict levels, while active community involvement in fence monitoring further reduced human–wildlife conflict ($p < 0.01$). Wild boar and monkeys remained the most frequent conflict species; however, the perceived effectiveness of fencing varied by species and structural integrity of the barrier. Beyond conflict mitigation, nylon net fencing also reduced zoonotic disease risks by limiting wildlife–livestock–human contact and contributed to improved livelihood security, with 70–80% of households reporting increased agricultural productivity. The findings demonstrate that nylon net fencing, when supported by consistent maintenance and community participation, offers a cost-effective and ecologically sensitive solution for human–wildlife conflict mitigation in the Sundarbans. This integrated approach strengthens both biodiversity conservation and socio-economic resilience, providing a scalable model for conflict-prone landscapes worldwide.

Keywords: Sundarban, tiger reserve, nylon net, human, wildlife conflict, estuarine ecosystem, barrier mitigation

Introduction

The Sundarbans, a globally significant biodiversity hotspot, is home to a diverse range of wildlife, most notably the Royal Bengal Tiger (*Panthera tigris tigris*). However, this sensitive ecosystem is currently under immense pressure from human encroachment and climate change, significantly disrupting wildlife migration patterns and breeding cycles. To address these challenges, the Forest Department has implemented nylon net fencing as a strategic measure (Das and Bandyopadhyay 2012) [6]. As noted, this material provides a cost-effective and adaptable alternative for creating permanent barriers, effectively separating wildlife movement corridors from human settlements and reducing instances of accidental encounters. The historical context of human-wildlife conflict in this region is complex, although instances of tigers preying on humans have been documented for centuries. (Gureja *et al*. 2002) [9] argue that the recent intensification of this conflict is a direct result of habitat fragmentation and the expansion of human resource extraction. Furthermore, (Macdonald *et al*. 2002) [12] state that large carnivores, as apex predators, are inherently prone to conflict due to their large home range requirements and competition for prey. This dynamic is not limited to terrestrial threats; between 1999 and 2009 and 29 crocodile attacks were recorded in the region, resulting in 12 deaths. The lack of artificial hatcheries has further exacerbated the vulnerability of local communities, forcing women and children to risk their lives collecting tiger prawn larvae. The socio-economic consequences of these interactions are far-reaching. Research by (Chowdhury *et al*. 2016) [5] indicates that 67% of tiger attacks occur during unauthorised forest entry, leaving survivors with severe economic hardships, social ostracism, and long-lasting psychological distress. However, technological solutions like nylon net fencing, inspired by local fishing techniques, have significantly reduced tiger incursions into villages (STR 2023-24) [2]. Researchers have increasingly advocated for a holistic management approach. Such a model would be successful by integrating community empowerment and income diversification with rigorous environmental monitoring

(Jamal et al. 2022; Das et al. 2024) [11, 8]. In conclusion, Sundarbans conservation is a scientific innovation defined by a unique synthesis of cultural resilience. Modern preventive measures, such as the use of masks facing backward to deter attacks by predators, coexist with honey collectors' continued reliance on the spiritual protection of the forest goddess. This combination of practical security measures and ancient belief systems provides a culturally sensitive framework for conservation. By acknowledging the biological needs of species such as deer and wild boar and the realities of local people's livelihoods, this research emphasises the necessity of a multidisciplinary approach to ensure the long-term survival of the Sundarbans.

Materials and Methods

- **Study Area**

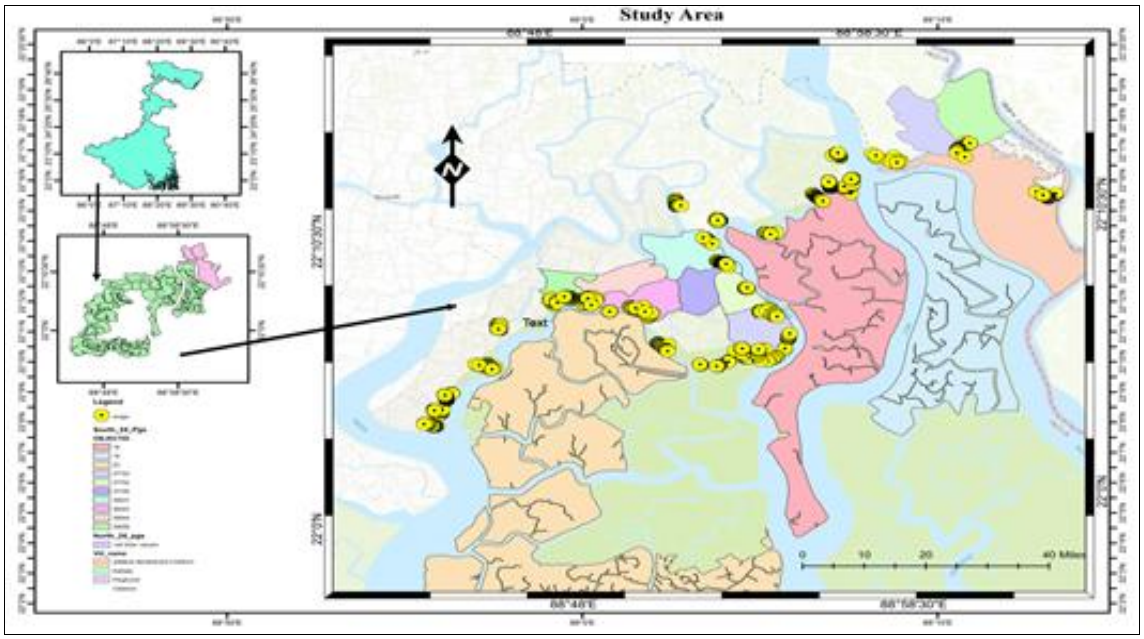

Fig 1: Geospatial Analysis of 108km Forest Cover and Survey Locations Using Satellite Data (Sundarban Tiger Reserve, West Bengal)

Data collection methods

Questionnaire Surveys: The local residents were surveyed through the structured questionnaire from 40 conflict-prone households of respective villages selected by 26 Joint Forest Management Committees with each JFMC involved in community development activities surrounding Sundarban Tiger Reserve (n = 1040) and the Forest Department (n = 32). The questions included information on the nature of wildlife arrivals, any other wild animals entering the village, preventive measures taken locally, and public awareness about nylon net fencing, which was collected from villagers belonging to each of the JFMCs. Results Responses were collected via interviews over the phone using the Kobo-Collect app. The data gathered offered useful information about the interactions between local communities and wildlife, highlighting both challenges and successes in conservation efforts. This approach facilitated the collection of crucial information and empowered villagers to engage more actively in wildlife protection initiatives.

Interview with Forest Staff and Villagers: Field interactions were conducted in the form of semi-structured interviews with forest department staff and officers, local public representatives, Gram Panchayat members, fishermen, and other villagers. Information gathered from these interviews also provided key inferences of historical human–wildlife conflict trends, on-going logistical issues related to nylon net fence maintenance, and the level, as well as structure, of community involvement in conflict mitigation. These insights not only illuminated the socio-economic factors influencing human-wildlife interactions but also highlighted the necessity for a collaborative approach in developing effective conflict resolution strategies. By helping stakeholders understand each other better, it is possible to come up with long-term solutions that help both wildlife and local communities.

Secondary Data: Secondary information had been collected from old records maintained by the Sundarban Tiger Reserve. These sources provided historical data on tiger intrusion, livestock depredation and human casualties, which were used to validate field observations and identify long-term conflict trends. This comprehensive analysis highlighted the increasing patterns of conflict between tigers and local communities over the years. By correlating these findings with ecological changes in the region, researcher aim to develop more effective conservation strategies that address both wildlife protection and community safety.

Data Analysis Tools Used: The raw data was analysed using Microsoft Excel & SPSS software for basic statistical purposes. Data spatialization: GPS-based datasets were processed and transformed into two-dimensional geo-referenced maps by means of QGIS and ArcGIS software.

Results

Table 1: Distribution of some socio personal & Socio psychological characteristics of JFMCs member in STR area of West Bengal

Variable	Category	Frequency	Percentage
Gender	Male	718	67.0
	Female	354	33.0
Age	10-40 years	372	34.7
	41-60 years	476	44.4
	61-100 years	224	20.9
Occupation	Agriculture	542	50.6
	Labourer	161	15.0
	Shopkeeper	19	1.8
	Fisherman	248	23.1
	Forest Department	32	3.0
	Others	70	6.5
Resident of Village	Less than 10 years	16	1.5
	10-40 years	67	6.3
	More than 40 years	989	92.3
Aware of The Nylon Net Fence installed near the jungle over the river	No	2	0.2
	Yes	1070	99.8
Nylon net fence installed	Don't know	24	2.2
	More than 10 years	52	4.9
	More than 16 years	996	92.9
Human-Wildlife Conflict last 5 years.	No	482	45.0
	Yes	590	55.0
Type of Human-Wildlife conflict	Others	661	61.7
	Livestock Loss	346	32.3
	Crop Damage	65	6.1
Animals are most commonly involved in conflict in area	Others	31	2.9
	Tiger	111	10.4
	Wild Boar	43	4.0
	Monkeys	260	24.3
	Jungle Cat	624	58.2
	Leopard Cat	3	0.3
Last time Tiger entered in village	More than 5 years	874	81.5
	Less than 5 years	186	17.4
	5 years ago	12	1.1
Current Condition of Nylon Net Fence	Don't know	19	1.8
	Excellent	62	5.8
	Good	991	92.4
Any gaps, animal trails, or water paths crossing the fence	Yes	23	2.1
	No	989	92.3
	Don't know	60	5.6
Noticed animals breaching or damaging the fence	Yes	29	2.7
	No	994	92.7
	Don't know	49	4.6
Animals cross the Nylon Net Fencing without Tiger	Wild Boar	47	4.4
	Deer	31	2.9
	Monkeys	423	39.5
	Others	571	53.3
Nylon net fence has reduced human-wildlife conflict	Don't know	6	0.6
	Yes Significantly	606	56.5
	Yes Somewhat	460	42.9
Villagers consulted before installation of nylon net fence	No	728	67.9
	Yes	344	32.1
Involved in any way in fence monitoring or Maintenance	No	981	91.5
	Yes	91	8.5
Received any training about human-wildlife conflict or fencing	No	310	28.9
	Yes	762	71.1
Willing to participate in a village-level wildlife conflict prevent prog	No	58	5.4
	Yes	1014	94.6
Receive support from forest/NGO regarding fencing or Conflict mitigation	No	756	70.5
	Yes	221	20.6
	Occasionally	95	8.9

The survey focused on the demographic and economic profile of the respondents, as well as the rate of crop destruction and experience of measures taken to reduce human-wildlife conflict. There was a significant gender bias, with women (33.02%) being twice as likely as men (66.98%). The age distribution showed that the majority of

respondents were between the ages of 41 and 60 (44.40%) and the youth were represented by those aged 10 to 40 (34.70%) *(Table No-01).* While the rate of those aged 61 to 100 (20.90%) was higher, this evidence suggests that the study population consisted mainly of middle-aged people who represented the active working class of society. The employed population profile indicated that agriculture is the primary economic activity in the region, with nearly half of the respondents (47.76%) identifying as farmers. There was also a big source of livelihood in fishing (21.12) and general wage labour (20.00), but only 11.12% of it was under services and business occupations. Reduced household sizes also shifted the agrarian design, which previously incorporated large rural households of 5-8 members, to place less emphasis on both small nuclear families and large joint families of 17 or more members. Living near the forest line exposes 82.84% of individuals to more frequent wildlife invasions. In this regard, 85.07% stated that they had direct experiences with crop damage from wild animals. Among cultivated crops, rice ranked in first place (54.10), then vegetable horticulture (32.54), and non-food grain miscellaneous crops (13.36). In response to the question of the primary culprits, villagers thought that wildlife is the greatest culprit (villagers favoured the wild boars, 73.58%), then deer (21.64%), and others (4.78%). This finding highlights the significant threat that wild boars pose to the sustainability of agriculture in the surveyed villages. This finding of (*Das C. S. 2017)* [7] reinforces analysed data in a very aggressive manner. The poll findings bring into the limelight the fact, that since the net fencing with nylon nets was installed, it has been playing an active and effective role in performing day-to-day life activity for the communities with more security and comfort. People are no longer compelled to live and work under constant fear of wildlife intrusion, which has significantly improved both their economic stability and overall quality of life. The most popular preventive technique applied in field protection has been nylon net fencing; 73.13%of the respondents used nylon net fence material to protect their fields. Monitoring the forest edge day and night by villagers was not popular, with only 1.59% of respondents participating; traditional fencing was used by 10.90%, and direct guarding by villagers occurred even less frequently at 15.97%. It is important to note that most participants (86.57%) expressed their opinion on the effectiveness of nylon net fencing, indicating a strong acceptance and trust in this new method of conflict control. In addition to personal efforts, the community's perception of collective management was overwhelmingly positive, with 94.59% expressing a willingness to participate in village management for addressing wildlife conflict, which is significantly higher than the 5.41% who expressed a similar level of collaboration. The situation regarding institutional backing was not positive. Most of the respondents (70.52%) indicated that they were not assisted by the forest officials or NGOs, with 20.62% being frequently assisted and 8.86% rarely assisted. This imbalance suggests that local demands are not aligned with foreign intervention; however, the villagers are eager to engage in organised managerial action. (Table No-01)

The analytical study reveals that, the vast majority of the sample population, which consists of middle-aged males (49-53 years) from small or medium-sized families, remained open to wildlife damage, particularly from wild boars that destroyed their predominantly paddy crops. Although on-the-ground intervention with nylon net fencing has proved to be an effective solution, it can be seen that there is poor institutional support in terms of structure. Simultaneously, there is a high level of community interest. Involvement in collective activities offers a unique opportunity to incorporate traditional knowledge and co-management approaches into more formal wildlife management initiatives.

Table-02: Analysis of the data contributes valuable knowledge on the use and associated factors of nylon net fencing in reducing human-wildlife conflict. Between the length of time that respondents had nylon net fences installed, an increase in the fences that have spent over 10 years in the slightly over 16-year-old fence lines has been observed. These fences have achieved a mean conflict level of 0.73, and fences that are less than 16 years old have achieved a value of 0.54.

Table 2: Assessing the Role of Nylon Net Fences and Village-Level Factors in Human-Wildlife Conflict and Mitigation in STR area.

Variable	Category	Human-Wildlife conflict last 5 yrs (Mean)	Chi-Square	Sig	Nylon net fence has reduced human-wildlife conflict (Mean value)	Chi-Square	Sig
Nylon net fence installed	Don't know	0.58	7.357	0.025*	1.21	42.896	.000
	More than 10 years	0.73			1.96		
	More than 16 years	0.54			1.55		
Animals are most commonly involved in conflict in area	Others	0.65	26.410736	0.000	1.61	38.844975360	0.000
	Tiger	0.63			1.76		
	Wild Boar	0.33			1.81		
	Monkeys	0.64			1.47		
	Jungle Cat	0.51			1.54		
	Leopard Cat	0.33			2.00		
Current condition of nylon net fence	Don't know	0.84	8.519	.014	1.26	3.681	.159
	Excellent	0.63			1.60		
	Good	0.54			1.56		
Any gaps, animal trails, or water paths crossing the fence	Yes	0.48	18.497	.000	1.61	8.795	.012
	No	0.54			1.57		
	Don't know	0.82			1.35		
Noticed animals breaching or damaging the fence	Yes	0.38	17.683	.000	1.66	8.983	.011
	No	0.54			1.57		
	Don't know	0.82			1.31		

This test, in its chi-square (7.557, p = 0.025), tells us that the duration of the installation score has a significant relationship with the conflict levels. Additionally, the perception of conflict reduction was significantly associated with the duration of fencing (the installation period) and has high statistical significance ($\chi^2 = 42.896$, p = 0.000); fences older than 10 years were considered very effective at reducing conflict. According to Bar *et al*. (2024) [4], after nylon net fencing was installed and regular monitoring was carried out by the Forest Department, conflicts with crocodiles and other wild animals reduced by almost 98–99%. This statistical data clearly shows how effective these measures are and gives strong support to the findings of the research (Table No-02). Wild boar (mean: 0.53) and monkeys (mean: 0.64) were the animal categories most frequently involved in conflicts, ranking third and fourth, respectively, due to their frequent incursions into human settlements. Chi-square ($\chi^2 = 26.107$; p = 0.000) analysis also indicated that the species type has a significant impact on the intensity of human–wildlife conflict. Respondents also perceived different degrees of conflict reduction among different species, with the leopard cat being considered to offer more perceived reduction (mean = 2.00) and the monkey being less so (mean = 1.47), which also showed strong statistical significance ($\chi^2 = 58.849$, p = 0.000). This result implies that nylon net fences could have different efficacy for different species. The state of the nylon net fence was also crucial. Households that rated fences to be in excellent condition (0.63) had a significantly lower mean conflict score than those that rated the fences as good (0.54). The value of the chi-square (8.519, p = 0.014) shows that the state of the fence was closely related to the levels of conflict; however, its effects on perceived reduction of conflict did not have significance (p = 0.159). The findings were an indication that an increase in the maintained fences minimises the perceived conflict on the ground; perceived effectiveness may not be as highly impacted.

The significance of structural deficiencies, such as- holes, animal tracks, and water channels along the fence route that crosses the stream or ditch, was also very high ($\chi^2 = 18.497$, p = 0.000). In contrast, mean conflict was much lower (0.48) among those who reported gaps than among those who did not, as were perceptions of effectiveness (mean = 1.61 versus 1.65). Respondents reporting that animals stripped or cut the fence were also different ($\chi^2 = 17.688$, p = 0.000). In patches with breaches, the average conflict was more than ε higher (0.58) than that in non-breach areas (0.54). Perception of conflict reduction also was statistically different ($\chi^2 = 8.985$, p = 0.011), with less effectiveness if a violation existed among respondents. It also considers that nylon net fencing is a useful approach for mitigating human–wildlife conflict. (STR 2022-23) [1] (STR 2024-25) [3]. However, the success of this approach is dependent on several interacting factors. The length of time that a fence has been in the ground, species complexity, physical integrity of the fence and presence of structural gaps or failures all impact users' experience with conflict as well as the communities' perceived effectiveness. Despite the widespread acceptance of nylon net fencing as effective, its performance primarily hinges on appropriate maintenance and species-specific issues.

Table 3: Statistical Relationships between Nylon Net Fence Installation, Maintenance, and Human-Wildlife Conflict Outcomes

Variable	Category	N	Human-wildlife conflict last 5 yrs (Mean)	Mann-Whitney U	Wilcoxon W	Z	Sig. (2-tailed)
Villagers consulted before installation of nylon net fence	No	728	.55	123784	389140	-.351	.725
	Yes	344	.56				
Involved in any way in fence monitoring or maintenance	No	981	.56	37622.500	41808.500	-2.881	.004
	Yes	91	.41				
Villagers consulted before installation of nylon net fence	No	728	1.59	112926	172266	-3.018	.003
	Yes	344	1.49				
Involved in any way in fence monitoring or maintenance	No	981	1.55	39122.500	520793.50	-2.268	.023
	Yes	91	1.67				

Table-03: The Mann–Whitney U test results provide insights into the relationship between community participation in nylon net fence management and the incidence of human–wildlife conflict over the last five years. Firstly, when comparing whether villagers were consulted before the installation of nylon net fences, the mean conflict values were very similar (0.55 for "No" and 0.56 for "Yes"), and the test result was not statistically significant (p = 0.725). This suggests that consultation before installation did not significantly influence the occurrence of conflicts. However, involvement in fence monitoring or maintenance showed a notable effect. Those not involved reported a higher mean conflict value (0.56), whereas those involved reported a lower mean value (0.41). This difference was statistically significant (p = 0.004), indicating that active participation in monitoring and maintenance helps reduce human–wildlife conflict. In the second analysis, mean values for conflict frequency showed that consultation before installation slightly reduced conflict (mean = 1.49 for "Yes" vs. 1.59 for "No"), with statistical significance (p = 0.005). Similarly, involvement in monitoring or maintenance increased the reported mean conflict (1.67 vs. 1.55), which was also significant (p = 0.025). Overall, these results highlight that while consulting the community before installing fences reduces conflict levels, direct participation in monitoring and upkeep is a more dynamic process. This engagement may in fact dilute the acrimoniousness of the disputes, while at the same time increasing their reported incidence (Table No-03).

Table-04: The correlation analysis indicates a relationship between factors such as- age and community involvement, and support received through knowledge, including training and institutional assistance, in managing conflicts. Age was slightly associated with a lower level of willingness to engage in conflict prevention schemes at local levels (r = –0.084, $p < 0.01$), meaning that younger adults are somewhat

more willing to be engaged than their elders. Being involved in either fence monitoring or repair was positively related to having received training on HWC or fencing (r = 0.120, $p < 0.01$), indicating that if someone is practically clubbed over the head with some faeces, so to speak, they will eventually get trained on how to do it. Similarly, training had a significantly positive association with support from forest departments and NGOs (r = 0.143, $p < 0.01$), indicating that trained respondents were more likely to receive institutional support. The other associations, including age, training, monitoring, and willingness to participate in support activities, were weak and not statistically significant. Taken together, the results suggest that training and policy support are mutually reinforcing with respect to CBO participation, Whereas-younger community members tend to be more motivated to participate in conflict prevention programmes (Table No-04).

Table 4: Correlation analysis for exploring the Impact of Community Involvement and Support on Wildlife Conflict Management and Fence Effectiveness in STR

	Age	Involved in any way in fence monitoring or maintenance	Received any training about Human-Wildlife Conflict or fencing	Willing to participate in a village-level wildlife conflict prevent program	Receive support from forest/NGO regarding fencing or conflict mitigation
Age	1	-.029	.029	-.084**	.029
Involved in any way in fence monitoring or maintenance	-.029	1	.120**	.014	.099**
Received any training about human-wildlife conflict or fencing	.029	.120**	1	-.007	.143**
Willing to participate in a village-level wildlife conflict prevent prog.	-.084**	.014	-.007	1	.046
Receive support from forest/NGO regarding fencing or Conflict mitigation	.029	.099**	.143**	.046	1

**. Correlation is significant at the 0.01 level (2-tailed).

Nylon net fencing in preventing zoonotic disease transmission from wild animals

Tigers (*Panthera tigris* tigris), wild boar (*Sus scrofa*) and spotted deer *(Axis axis)* share habitats with people in regions such as the Sundarban. These interactions not only result in increasing human–wildlife conflict, but also pose the risk of zoonotic diseases, i.e., the pathogen spill over from wildlife to humans. (Prpić *et al*., 2024) [14] (Zoonoses and Wildlife: One Health Approach, 2022) [16]. For example, diseases such as- leptospirosis or swine fever can be passed from wild boar to humans through the direct infection of water and soil. Spotted deer with ecto-parasites such as- ticks are infected with tick-borne diseases, including Lyme disease. While tigers rarely have direct disease transmission, some bacteria and parasites can be transmitted by tigers, for example, Mycobacterium Bovis (*Bovine tuberculosis*), which can spread through carcass consumption or dogs. One of the major achievements of this work was that the installation of nylon net fencing has reduced them on a significant scale, and it creates a physical barrier to prevent wildlife from entering farmlands and water bodies in villages (Petrovan *et al*., 2021) [13] (Tumelty *et al*., 2023) [15] (Hussain *et al*., 2024) [10]. This in turn far lowers the chance for disease transmission (dropping communicable faecal, urine or biting wildlife infection rates). Also, with a reduction in livestock predation events, people are no longer as likely to interfere with injured wildlife—a leading cause of transmission of disease in the past. The resulting reduced contact between domestic animals and wildlife also greatly reduces the prominence of interspecies disease transmission.

Villager perception and fence effectiveness

A local resident based questionnaire survey was used to assess overall experiences with the project, and more than half reported a positive experience. Most (85–90% of all respondents) villagers felt safer at night and said that the fencing had prevented wild boars and on some occasions, tigers from entering the village during night time hours. However, some doubts were expressed regarding the upkeep of the fencing during monsoons and instances where small breaches or holes would develop.

Wildlife movement patterns near fenced areas

Patterns of wildlife movement near the nylon net fencing were observed in the field as well as in traditional GPS tracking studies from the Forest Department. I observed wild boars and spotted deer many times moving along beside the fence, but none have crossed it. Here, sometimes even forest personnel and local villagers have noticed tigers walking besides the fencing or resting near it, but the tigers didn't go any further, indicating that the fencing acts as a barrier not only physically but also psychologically.

Maintenance and durability observations

Six months of continuous monitoring revealed that nylon net fencing demonstrates considerable durability; it has sustained localised damage in cyclone-prone zones, primarily due to persistent tidal currents and the impacts of climate change. The Forest Department undertakes prompt maintenance and repair operations in remote locations whenever the fencing is torn or compromised, particularly in cases of riverbank collapse during extreme weather events. Most structural damage is attributable to excessive vegetation overgrowth, flooding, or other mechanical factors. Cost-effective maintenance measures are systematically implemented with the active participation of local forest workers and trained community members, while Joint Forest Management Committees (JFMCs) play an important supportive role in ensuring the long-term functionality of the barrier.

Socio-economic impact on villagers

All the villagers were able to have their occupations greatly improved after the nylon net fencing was installed. The improvement in the villagers' occupations is primarily attributed to a significant decrease in crop and livestock losses, with 70% to 80% of households reporting higher agricultural yields (Table No-01) (Figure-11). Reduced danger of tiger conflict also carries a boost for these individuals, who now have greater freedom of movement within the forest fringe — though they are still barred from certain protected zones and can only enter with a proper permit. Together, the economic and social gains from the Nylon Net Fencing project are a significant return on the original financial or logistical input required to run such an initiative.

The findings showed that repeated exposure to nylon net fencing has raised an overall awareness of these structures in residents of the JFMC villages. The majority of respondents who answered the questions have lived in the area for nearly 40 years, relying solely on farming, day labour, and fishing for their livelihoods. About 16 years ago, the forest department-built nylon net fencing for the first time on the side of the river to enclose the forest. It even recorded a reduction of nearly 98 per cent in the number of tiger incursions into villages in the past five years since installation. In such rare instances when the tigers come near, they usually retreat from the riverbank and go back into the forest.

Villagers reported that the Forest Department conducts daily fencing checks and asserts that the fencing is in perfect condition. A new threat has emerged in the Sundarban Tiger Reserve: wild cats are preying on domestic poultry, such as chickens and ducks. Locals claim that all the fencing around the affected areas on both sides of the river, including the poles and wires next to settlements, is intact and shows no signs of damage. In isolated cases, it is possible that wild monkeys and other small wild animals make their way in from the surrounding woods. Such intrusion sees a quick response from the local public, who inform the Sundarban Tiger Reserve authority, and accordingly, they trap and, if needed, administer a vet treatment and then allow it to come back into the forest. NGOs and JFMC committees also provide assistance to the local communities. Additionally, the villagers have expressed a desire for better protection than the nylon net fencing currently in place.

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Discussion

Effectiveness of Nylon Net Fencing in Conflict Reduction

The installation of nylon net fencing at forest peripheries in the Sundarban is an important bio-social and technical intervention to alleviate human-wildlife conflict. After the fencing of such villages, there has been a visible decline in village incidents (the tigers no longer come inside the villages, and depredation by deer and wild boars too has reduced significantly), as confirmed by ground (field observation) data and structured interviews with villagers. This barrier is also a form of behavioural deterrence, especially for tigers and wild boars, whose lightweight yet durable qualities cause them to be deterred by their natural movement patterns. This study provides evidence that nylon net fencing can function as both an effective barrier and a psychological deterrent at locations that were previously identified as conflict hotspots, as manifested by significant reductions in recorded conflict events. Nylon net fencing helps to indicate the presence of wildlife from a distance and is constructed of yellow nylon netting, which provides an attractive visual warning signal. This early alert causes the animals to change their movement much before they are near human habitats, which in turn reduces possibilities of conflict. As a result, the yellow nylon net fence has become an effective way to deter animals both behaviourally and physically.

Scientific significance of yellow colour

- **High Visibility:** The yellow colour (presumably between 570 and 590 nm) is one of the most detectable colours observed in typical daylight conditions, significantly more so than other hues and possibly more detectable by many wildlife species. This wavelength marks aposematic colouration, a common warning signal for species that are toxic or venomous.
- **Psychological Deterrence:** Studies have shown that bright colours, especially yellow, trigger an alert or panic response in animals. Such behaviour hinders their normal movement, causing them to avoid residential areas.
- **Night-time Reflectivity:** Some nylon barricades are designed with retro-reflective yellow elements that reflect incident light, such as that from a torch or car headlamps, back to its source. This increases night visibility, which helps in the early detection of the fence and minimises wildlife–human encounters or vehicular collisions due to the sudden appearance of a physical barrier.

- **Visual Cue for Humans:** That bright yellow colour, while being a deterrent, also acts as an obvious visual cue for citizens who live locally to serve as a reminder that they are entering the 10% restricted or protected areas. It allows officials from the Forest Department to spot and correct damaged sections faster.

Conclusion

The installation of nylon net fencing around the high-risk villages of the Sundarban Tiger Reserve has brought a major positive shift in reducing human–wildlife conflict. Before this intervention, incidents of wildlife entering villages and attacking livestock were very common and created constant stress for local communities. After the Forest Department completed the fencing, despite extremely difficult environmental conditions and serious logistical challenges, the number of conflict cases dropped noticeably. On-going field monitoring has consistently supported this improvement. Community surveys further confirmed these changes. Most residents reported feeling much safer, with less fear of wildlife threats and a stronger sense that peaceful coexistence between people and wildlife is now possible. During field observations, the researcher also noticed clear changes in wildlife movement, with many species spending more time inside core forest areas rather than near human settlements. However, some practical challenges still remain. The fencing requires regular maintenance, and the nylon material is vulnerable to damage from strong sunlight and salt exposure over time. In addition, sections of fencing located near tidal zones are particularly at-risk during storm surges and extreme weather events. Addressing these concerns will be essential to ensure the long-term success of this conflict-mitigation strategy in Sundarban Tiger reserve area.

Recommendations

Thus, the nylon net fencing has made a considerable breakthrough and is playing a substantial role in controlling human–wildlife conflicts in those rural areas in the high-risk zone of the Sundarban Tiger Reserve. Previous to the intervention, wildlife intrusion and predation on livestock were extremely common. The number of such cases has remarkably fallen since the Forest Department of the Sundarban Tiger Reserve erected the periphery fencing, despite facing near-impossible environmental and logistical challenges, which have been further supported by on-going rigorous monitoring. A series of surveys conducted with residents supports this, highlighting the positive benefits of an enhanced feeling of safety due to reduced concerns about wildlife threats and an increased perception of advantageous cohabitation between people and wildlife. The researcher also observed notable shifts in the movement patterns of wildlife, with numerous species focussing on core forest areas. Nevertheless, there are still some operational issues to address, such as- need for maintenance, susceptibility of nylon to UV radiation and salt induced degradation over time, and fencing that is exposed along tidal areas and likely to endure damaged during a storm surge in the Sundarban Tiger Reserve area.

Data availability statement

The researchers have collected the primary data with the help of a structured interview schedule after taking due permission from the competent authority. He also took the help of secondary data during the analysis in the study.

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