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Socio-economic status and perception of fishermen towards resolving human-tiger conflict around Sundarban Tiger Reserve, India

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Abstract

Periodic losses due to large carnivores, be it livestock depredation or death of a family member stimulates fear psychology in the subconscious mind. Thus perceptions of certain species as innately evil or harmful means that even if wildlife damage is entirely mitigated, residual fear and antipathy can lead to continued persecution nonetheless. The socio-economic status and perception of fishermen (n=115) towards tigers along the peripheral villages of Sundarban Tiger Reserve were examined by conducting semi-structured questionnaire surveys between December 2011 and June 2013. Majority of the respondents (66%) resided in kutcha households vulnerable to damage by frequent natural disasters, and 59% of them illiterate and never attended school. Sixty two per cent of the respondents opined that the main role of tigers were to destroy and subdue other life forms, while 67% stated that the declaration of Sundarban Tiger Reserve was not beneficial to their livelihood. Promoting sustainable employment opportunities, organizing educational and awareness programmes about tiger attacks, increasing compensation schemes for tiger victims are important socio-economic measures most likely to reduce human-wildlife conflict.

Key words: attitude, conflict, livelihood, Sundarban and tiger.

INTRODUCTION

Large carnivores are widely acclaimed for inflicting damage on valuable resources especially livestock and occasionally human lives. This has been attributed to the cause of revenge killings and for the negative perception towards their future persistence in human-dominated landscapes (Naughton-Treves, 1998; Naughton Treves et al., 2003; Treves and Karanth, 2003; Inskip and Zimmermann, 2009). Accordingly, understanding and addressing local people's attitudes and behaviour towards human-wildlife conflicts in relation to both social and ecological aspects are vital for successful conservation of many species and are considered as major thrust area of research (Wang and Mac Donald, 2006; Palmeira *et al*., 2008; Ogra, 2009). People who got encountered with conflict and unable to perceive are unsuccessful in ameliorating the problem obviously developed the attitude of revenge against such wildlife and frequently retaliate the animal (Mills and Hofer, 1998).

Humans have a dynamic relationship with carnivores, few events are sufficient to affect peoples' attitudes and shape their future interactions with particular species. Peoples' perceptions are not only based upon facts and personal experiences, but also upon a myriad of factors such as wider societal experiences, cultural norms, expectations and beliefs (Conover, 2002; Woodroffe *et al*., 2005). These factors, although play crucial role in human–wildlife conflict, yet are rarely considered.

Tiger-human conflicts have already contributed to the decline and extinction of two sub-species i.e. Bali tiger (*Panthera tigris balica*) and Javan tiger (*Panthera tigris sondaica*) (Hoogerwerf, 1970; Seidensticker, 1987) and there is an urgent need to characterize and develop measures to reduce these conflicts (Nowell and Jackson, 1996; Woodroffe and Ginsberg, 1998; Linnell *et al*., 1999). Tigers have been infamous for attacks on people, livestock since centuries be it Terai landscape of Nepal and India, Russian Far-East and parts of South-east Asia. Unlike other tiger populations of South-east Asia, tigers of Sundarban are held responsible for a considerable number of human deaths annually, considered to be the highest in the world (Montgomery, 2008). Sundarban tigers of India and Bangladesh form a single population which is isolated from other tiger populations and the only one in a mangrove habitat (Dinerstein *et al*., 1997).

According to local legends about 100 years ago 4,218 people were eaten by tigers in just six years (Montgomery, 2008) while historical records indicate that 800 human lives were lost in a span of 20 years in the undivided Sundarban (Chakrabarti, 1992). More recent estimates proclaim that on an average 36 lives are lost to tigers every year on the Indian side of Sundarban, and only 28.5% of victims' bodies have been recovered (Chakrabarti, 1992). Majority of these tiger victims have been fishermen, honey collectors and woodcutters by profession as documented by several researchers over a period of time (Chowdhury and Chowdhury, 1994; Chowdhury and Ahmad, 1994; Khan, 2004; Sanyal, 1987; Denzau and Denzau., 2010). The intensity of human lives lost to tigers is further reiterated through the existence of tiger widow villages or 'vaidabapallis' where every woman in the village

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has lost either son, father or husband to tigers (Montgomery, 2008). Thus, local belief is that the "unofficial" figures of those killed by tigers can be far higher than the official figures provided by the administration as all deaths are not reported (Montgomery, 2008). Apart from man-eating tigers entire Sundarban region is under the intense human population with around 3.5 million people living within 20 kilometres of its northern and eastern borders and depending upon the forest resources for livelihood (Chakrabarti, 1992).

Examination of the social aspect of tiger conservation requires investigations on the values and behavioural intentions held by people whose interests may conflict with the presence of tiger. Built on this value are patterns of basic beliefs or value orientation, attitudes, norms, behavioral intensions and behaviours (Rokeach, 1973; Homer and Kahle, 1988; Fulton *et al.,* 1996). For example, measure of tiger's values people hold will be the best predictor for attitudes towards tigers. Therefore, it is critical to understand wildlife value orientation that forms the basic foundation explaining the human behaviour related to wildlife.

Majority of the conflict mitigation studies focus only on the technical aspect of conflict reduction, yet social factors, ethnicity, religious affiliation and cultural beliefs shapes the outcome of conflict. Human-wildlife conflicts are often manifestation of underlying human-human conflicts, be it between authorities and local people or people with diverse cultural backgrounds. In spite of ample evidence for social factors playing crucial role in driving conflicts they are often ignored in the studies on conflicts (Dickman, 2010). Currently, the attitudes of urban people towards the large carnivores are mostly favourable; but the conflicts still exist locally among the economically marginalized rural communities whose livelihoods are directly or indirectly threatened by large carnivores. Ultimately people do learn to coexist with large carnivores. Nevertheless periodic and frequent losses ignite the fear psychosis and hatred towards the large carnivores; that are attributed to the human fear psychology (bio-phobic or bio-philic) and peoples' concern about their own safety and health (Røskaft *et al.,* 2003).

Thus keeping in perspective of the recurrent loss of family members, companions and colleagues due to tiger attacks, the present work was carried out to a) assess the perception of fishermen towards tigers in Sundarban, b) evaluate socio-economic condition of fishermen, and c) investigate the reasons for being dependent on forest based livelihood in spite of it being an occupational hazard.

METHODS

Study Area

Sundarban is the world's largest contiguous mangrove forest created at the confluence of the deltas of Rivers Brahmaputra, Ganga and Meghna. The delta spreads across the countries of India and Bangladesh covering 80,000 km^2 (Chakrabarti, 1992) with 38% (Mitra, 2000) of it in India and the remaining in Bangladesh. It comprises of mudflats, creeks, tidal channels and an archipelago of about 102 islands of which 54 are inhabited by human population (Bera and Sahay, 2010). The Indian part of Sundarban covers about 4,266 km^2 (Sen and Naskar, 2003) in the 24 Parganas district of West Bengal, with parts of the region submerged under water (Fig. 1). It lies in the biogeographic zone 'Coasts' in the province of 'East Coast' as per Rodgers and Panwar's (1988) classification. The Protected Area of Sundarban comprises of 2,585 km^2 with a unique ecosystem of which 1,330 km^2 has been designated as the core zone of the Sundarban National Park. Amongst the larger fauna, tiger *(Panthera tigris tigris),* estuarine crocodile (*Crocodylus porosus*), water monitor (*Varanus salvator*), and three species of terrapin and turtles: northern river terrapin (*Batagur baska*), softshell turtle (*Pelochelys bibroni*) and green sea turtle (*Chelonia mydas*) are native to this region. Among the cetaceans, the Irrawaddy (*Orcaella brevirostris*) and Gangetic dolphins (*Platanista gangetica gangetica*) are rare and endangered. The main prey of tiger in the region comprises of chital (*Axis axis*), wild pig (*Sus scrofa*) and rhesus macaque (*Macaca mulatta*) and lesser adjutant (*Leptoptilos javanicus*) (Khan, 2004).

Socio-economic profile and Colonization History of Sundarban

The Indian Sundarban comprises of 19 community development blocks, with an estimated population of 4.1 million people (Census of India, 2001). Forty four per cent of the population comprises of schedule caste and tribes, with 85% dependent on agriculture. Other major occupations of the region are fishing, pisciculture, wood cutting and honey collection. The literacy level and per capita income are significantly below the state average with majority of the people below the poverty line. The human population density of this region is amongst the highest in the country with 1437.4 persons/km^2 (Qureshi *et al.,* 2006) making the biodiversity conservation a challenge, although the Tiger Reserve is free of human settlements. Human colonisation of this region happened relatively late due to the inhospitable conditions though some people did occupy the area even in 6th century (Chakrabarti, 1992). By 1878-79, 4856 km^2 of this area was designated a Reserved Forest (Bera and Sahay, 2010; Bera et al., 2010). In 1978, many partition refugees from Bangladesh

escaped from the Dandakaranya government resettlement camp in central India and decided to establish themselves at Marichjhanpi in Sundarban, an area that was until then free of human presence and categorised as a Reserved Forest. This act led to violent clashes between the new settlers and the state government and resulted in mass deaths, brutality and disease in the region (Ghosh, 2004). Most of the areas are inaccessible, with poor communication and transport network. Frequent natural disasters such as cyclones and inrush of tidal waves and flooding results in widespread damage to life and property. In 2009, cyclone Aila caused considerable devastation rendering thousands homeless and leaving hundreds dead across the Sundarban (Choudhury *et al.*, 1999).

Socio-economic interviews

115 fishermen from 19 peripheral villages of Sundarban Tiger Reserve were interviewed (Fig. 2) between December 2011 and June 2013 using closed and open ended structured questionnaires (Bath, 1987; Bernard, 1995) to assess their socio-economic conditions, dependence on forest resources and attitudes toward conserving tigers in the landscape. Apart from fishermen people from other major occupation groups such as agriculture, pisciculture, tourist helpers, boat owners, hotel owners and daily wage labourers were also interviewed to infer about their annual income. Fifteen households who lost at least one of the family members due to tiger attack were also interviewed to understand their socio-economic status.

All the respondents were adults (above 18 years old) and those who willing to participate were interviewed. Interviews were conducted in the local language in an informal way to acquire desired information. The initial questions were related to simple demographic information so as to make ease the respondents to the interview session. Questions were repeated several times to ascertain the genuinity of the information provided by the respondents and the response was recorded only when there was no ambiguity. The questionnaire survey was primarily conducted by the same members of the research team to maintain uniformity and reduce individual bias while scoring of the answers.

A family was treated as the basic unit for the purpose of this study, with only one respondent from a family was interviewed. The respondent was treated as a representative of the family unit. The structured questionnaire used was divided into three main sections. The first section primarily dealt with the demographic details (age, gender, caste, education level, household structure, etc.) and assessment of the economic condition of the respondent was also made (Ranjitsinh and Jhala, 2010). The second part included questions pertaining to socio-economic status including land holding, livestock owned and annual income. The final section comprised questions regarding knowledge of tigers, human-tiger interactions, perception towards tiger conservation and suggestions for mitigating conflict. Information regarding the areas preferred by the respondents for fishing and honey collection was also collected.

Analytical Procedure

Responses from the questionnaire survey were analyzed to evaluate basic statistics regarding socio-economic well being, primary source of livelihood, attitude and perception of local people towards tigers (Ranjitsinh and Jhala, 2010). Percentages for each response were calculated based only on those who answered the respective questions. Significant difference between response of respondents was determined by using chi-square analysis in SPSS version 17.0 (SPSS Inc., Chicago, USA) and (R 2.15.1). Based on the records of the forest department, a map was prepared depicting the spatial intensity of human deaths caused by tigers between 2001 and 2013 in Arc GIS 9.3 (ESRI, Redlands, CA, USA). Maps for fishing intensity and honey collection within different administrative blocks of Sundarban Tiger Reserve were also generated using Arc GIS 9.3 (ESRI, Redlands, CA, USA) based on the questionnaire surveys. The lifetime income from the respective occupation was evaluated taking into consideration of an earning span of 47 years (18-65 years), 18 being the standard age of getting into a profession (derived from questionnaire surveys) and 65 years being the average life expectancy in South and North 24 Parganas District West Bengal. According to Chakrabarty (1992) and Khan (2004) majority of the human deaths caused by tigers were middle aged men between 35 to 45 years and hence the average age of tiger victims was calculated as 40 years. The income generated was also compared to other occupations of the respondents corresponding to that age.

RESULTS

Socio-economic condition of fishermen

The average age of fishermen interviewed was 50 years (SD 14.23). The average number of family members of the respondent was 5 (SE 0.24)**.** Majority (66%) stayed in kutcha houses (mud huts), while 33% stayed in semi-pucca houses (brick walled with hay or clay tiles top) and a mere 1% in pucca houses (X^2= 63.38, df = 2, $p < 0.05$). Roof material used in most of the households comprised of thatch and hay 64%, asbestos 3%, concrete 2% and tin sheets 31% (X^2= 102.8, df = 3, $p < 0.05$). Seventy one per cent had their ancestral home in Bangladesh followed by 12% from parts of North 24 Parganas district, 8% from Medinipore, 7% from parts of South 24 Parganas district and 2% from other parts

of West Bengal (X^2= 165.1, df = 4, p < 0.05). Most of the respondents (59%) were illiterate, 22% having completed primary schooling (till class V), 16% not completed primary school and only 3% with secondary schooling completed (X^2= 69.2, df = 3, p < 0.05).

Group composition of fishermen and honey collectors

Majority (69%) of honey collectors comprised of groups of 6-9 persons, 23% with 2-5 persons and 8% having more than 10 persons (X^2= 60.62, df = 2, p < 0.05). Fishing groups consisted of 3 persons 57%, 4-6 persons 41% and more than 6 persons 8% while going for harvesting fish inside the forest (X^2= 30.38, df = 2, p < 0.05). Seventy three per cent favoured spring tide phase for fishing and crab collection followed by 27% dependent on neap tide phase for extraction (X^2= 21.16, df = 1, p < 0.05). As means of self defense 86% used machete, 5% wooden sticks and poles and 8% used nothing (X^2= 127.82, df = 2, p < 0.05).

Perception and knowledge of fishermen towards tigers

Majority (92%) of fishermen opined that tigers consider humans as natural prey, only 5% stated that they attacked in self defense while 3% did not have an answer to the question (X^2= 154.94, df = 2, p < 0.05). Sixty two per cent of fishermen said that the main role of tigers in the wild is to destroy and subdue other animals, 19% said that they maintained ecological balance, control prey populations 14% and rest 5% were unaware of any role played (X^2= 77.04, df = 3, p < 0.05). Sixty seven per cent of the respondents opined that the declaration of Sundarban as Tiger Reserve was not beneficial to their livelihood, 20% felt it was useful, 8% said that only a fraction of the community has benefitted out of it whereas the rest 5% said that Forest Department and the state government did not provide any benefits whatsoever (X^2= 99.12, df = 3, p < 0.05).

Seventy seven per cent believed that prayer to Bonbibi (Forest Deity of Sundarban) before venturing in to the forest and rituals by shamans, could effectively prevent tiger attacks and the rest 23% felt that they were ineffective and presence of mind was crucial to prevent such conflicts (X^2 = 29.16, df = 1, p < 0.05). Majority (93%) were of the view that human negligence was responsible for deaths inflicted by tigers and 7% felt that Forest Department, being the custodians of the forest, was responsible for human deaths due to many reasons (X^2= 73.96, df = 1, p < 0.05). The reason as to why tigers stray into human habitation and depredate on livestock was attributed primarily to loss and scarcity of natural wild prey 67%, followed by easy target in the form of livestock 13%, narrow channel separating villages from forest 12%, confusion with tiger habitat 5% and encroachment of forest land 3% (X^2= 144.99, df = 4, p < 0.05).

Annual income of local communities

Since tiger attacks were frequent on people of particular occupations (honey collectors and fishermen), such category of respondents were asked as to whether they were willing to switch their profession. Majority (84%) declined to comment and only 16% responded positively for a changeover (X^2= 46.24, df = 1, p < 0.05). When inquired about their profession which involves high risks, 39% said that it gave instant cash rewards, 39% cited no other alternative means to secure income, 5% spoke about limitations of agriculture and rest 17% stated that they were best and apt at this compared to other sources of livelihood (X^2= 34.24, df = 3, p < 0.05) (Fig 3).

Occupation wise annual income as evaluated from socio-economic surveys was in the following order: hotel owner (INR 3,00,000) > Boat owners (INR 2,00,000) > Shopkeeper (INR 80,000) > Fishermen, Crab Collector, Honey Collector (INR 74,282) > Agriculturist (INR 44,377) > Animal Husbandry (INR 36,000) > Tourist Guide (INR 24,000) > Daily wage laborers (INR 15,000-26,000) (NREGA 2013 West Bengal Government wage rate; 1 INR H″ 60 US$) ($X^2$= 735886, df = 7, p < 0.05). Apart from agriculture, shopkeeper, boat owner and hotel owner, income from forest based livelihood was significantly more than the daily wage labourers, tourist guides and apiculturists. A comparative analysis of the overall income generated till the age of 65 years revealed that a fisherman earned better than others except shopkeepers, boat owner and hotel owners who get income through tourism (Table 1).

Socio-economic condition of tiger victim's family

Out of the family members interviewed 60% were dependent on forest based livelihood, 20% worked in cities such as Kolkata, Chennai, and Andaman, 13% were agriculturists and the rest 7% daily wage workers. Fifty three respondents stayed in kutcha household whereas 47% in semi-pucca households. Sixty seven per cent of the respondents had access to solar light and the rest 37% stayed without any light facility**.** Half of them 53% were illiterate, 27% completed primary school and the rest 20% did not complete primary schooling.

Spatial distribution of the intensity of fishing and honey collection across Sundarban Tiger Reserve

Based on the map derived from Arc GIS (Fig 4 and 5) fishing and honey collection intensity were the highest along the north-western part of the tiger reserve. Honey collection was also common in the eastern part of the tiger reserve. Moderate level of fishing was done along the northern and central portion of the reserve. North-western part of the reserve being close to peripheral villages seemed easily accessible by majority of

Figure 1. Map of Sundarban Tiger Reserve,West Bengal India

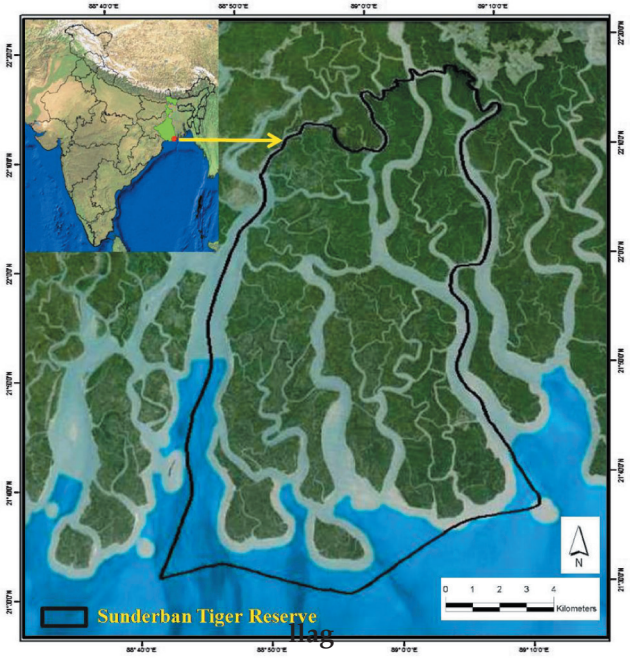

Figure 2. Map of Sundarban Tiger Reserve, India with locations of interviews conducted along peripheral

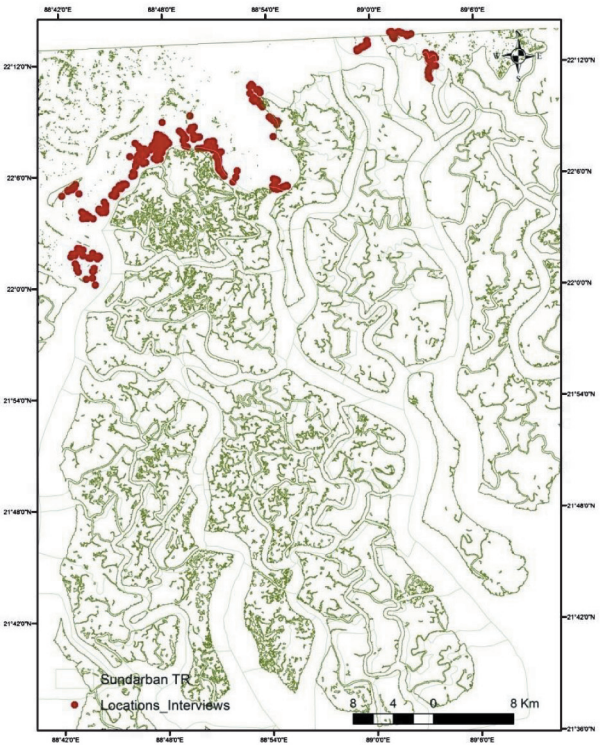

Figure 3. Response of fishermen regarding dependence on forests in spite of threats by tigers (X^2= 34.24, df = 3, p < 0.05)

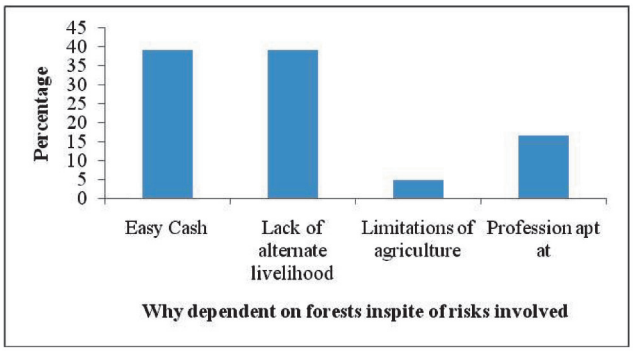

Figure 4. Fishing intensity across the administrative blocks of Sundarban Tiger Reserve

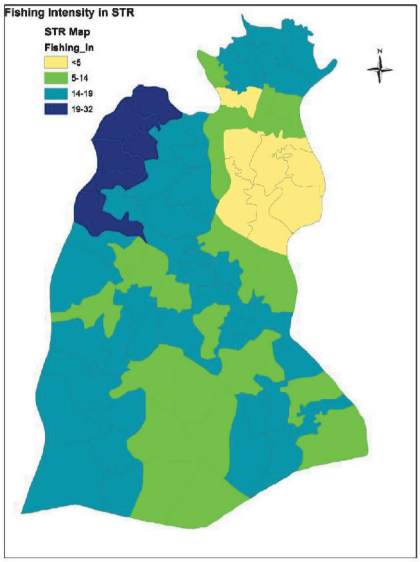

Figure 5. Honey collection intensity across the administrative blocks of Sundarban Tiger Reserve

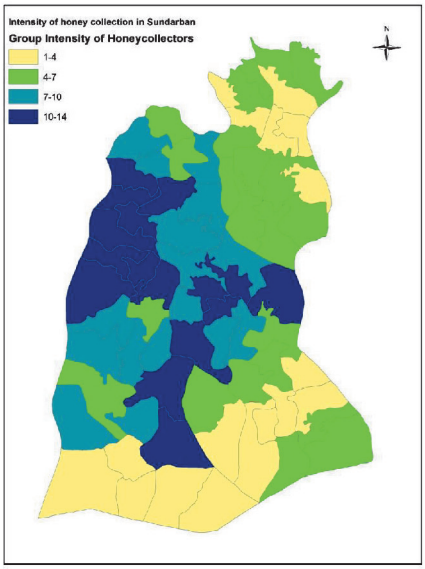

Table 1. A comparison of annual and lifetime occupation wise income to show as to how financially it is advantageous to be dependent on forests in spite of the risks involved

Major Professions	Annual Income INR	Lifetime Income (18-65) years INR	Surplus/Deficit compared to income at 40 being a fisherman INR	Surplus/Deficit lifetime income being a fisherman INR(18-65) years
Agriculture	44,377	20,85,719	Deficit-4,51,515	Surplus 14,05,535
Tourist helper	24,000	11,28,000	Surplus 506204	Surplus 23,63,254
Shopkeeper (Tourist Zone)	80,000	37,60,000	Deficit-21,25,796	Deficit -2,68,746
Animal Husbandry	36,000	16,92,000	Deficit-57,796	Surplus 17,99,254
Apiculture	16,000	7,52,000	Surplus 8,82,204	Surplus 27,39,254
Fishing, crab & Honey Collection	74,282	34,91,254		
Boat owner	2,00,000	94,00,000	Deficit	
Hotel owner	3,00,000	14,100,000	Deficit	
Daily wage NREGA Unskilled	15,100	7,09,700	Surplus 24,504	Surplus 27,81,554
NREGA Semiskilled	19,500	9,16,500	Surplus 7,17,704	Surplus 25,74,754
NREGA Skilled	26,000	12,22,000	Surplus 4,12,204	Surplus 22,69,254
If dies at 40 yrs due to tiger attack		16,34,204		

fishermen and honey collectors. Eastern part being near the international boundary of Bangladesh and relatively far flung from human habitation recorded low intensity of fishing. Rest of the northern and central part recorded moderate level of honey collection. Apparently maps based on fishing and honey collection depicted certain hotspots along the northwestern part close to human habitation.

DISCUSSION

Inskip and Zimmermann (2009) stated that poverty, low levels of literacy, lack of alternate livelihood, meager income, harsh climatic conditions and high levels of conflict intensity form a complex web which ultimately shaping negative perception towards tigers in Bangladesh Sundarban. Fishermen interviewed were mostly illiterate residing in mud huts, making them vulnerable against frequent natural calamities prevalent across the region. Though majority of the fishermen are proficient in harvesting natural resources with excellent natural history skills, their basic knowledge about tigers is somehow shaped by popular myths and local folklore of the region. Sixty per cent of them disliked tigers. This is because of the fact that they are dependent on forests and have regular interactions with tigers, which sometimes prove fatal at any point of time. Local pastorals experiencing livestock depredation problem were equally intolerant to snow leopards especially in the Western Himalayas (Bagchi and Mishra, 2006). Though armed with a machete or wooden poles, sticks, majority of the fishermen and honey collectors are followers of the forest deity-Bonbibi and performed rituals and ceremonies before venturing into the forest. Similar beliefs have been reported from Sumatra where holy men communed with tigers in order to speak to dead heroes, In Thailand and peninsular Malaysia tiger is regarded as the avenger of the Supreme Being- Karei, and those who are breaking or disobeying tribal taboos are punished. In a place with dire poverty levels and limited employment opportunities it makes sense to take the extra risk of securing a stable income for the family. Families of fishermen killed are paid a meager compensation of INR 2,00,000 by the Forest Department only if the victim died outside the designated core area of the Tiger Reserve (ACF, DFO Sunderban Tiger Reserve Pers. communication). Thus most of the incidents inside the PA go uncompensated. As it has been reported that (Kumar and Rahmani, 1997; Khuukhenduu and Bidbayasakh, 2001; Verdade and Campos, 2004) paying for wildlife damage can ostensibly stimulate local support for conservation, reduce incentives for retaliatory action and buy time for alternative management practices (Nyhus *et al.*,

2005; Wang and MacDonald, 2006). Sixty per cent of the family members of tiger victims' interviewed were dependent on forests which testify their resilience and courage, and expose the lack of alternate employment opportunities. Loss of a human life doesn't really seem to be a deterrent in the struggle for existence, which is probably worth exploring considering the economic benefits and the occupational hazards.

CONCLUSION

An isolated tiger population of Sundarban faces threats of local extinction prominently due to human-tiger conflict. Hence garnering local support becomes essential for conservation through mitigation or management of conflict. Loss of human life and fatal injuries inflicted by tiger attacks cannot be compensated by money yet they might engender public support and reduce the pain and agony of the family members. Enhancing the quantum value of compensation is justified on the grounds of morality, when the direct costs incurred on conservation are felt by a small minority (Treves *et al*., 2009). Northwestern part of the tiger reserve being frequented by people, might surface as a hotspot of conflict and restraint on harvesting natural resources should be imposed by the forest department to reduce the risk of tiger attacks on humans. Though majority of the Tiger Reserve is inaccessible for fishing, crab collection, forest department might consider opening of additional areas outside the risk zone to enhance employment generation opportunities. Ultimately conservation of tigers in Sundarban needs a holistic approach not only focusing on the endangered species but also integrating the socio-economic needs of the local inhabitants. Considering limitations of livelihoods, promoting eco-tourism might provide a gradual shift from present forest based sustenance. Though marginal local communities like fishermen have learned to co-exist with tigers in spite of recurrent economical or personal losses, the future depends on finding permanent solutions to mitigate human-tiger conflict.

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