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AN ASSESSMENT OF FARMERS' ATTITUDES TOWARDS CROP DAMAGE BY WILDLIFE AND ITS PREVENTION METHODS IN THE ARID LANDSCAPE OF GUJARAT

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This work was carried out in collaboration among all authors. Authors SD, HT and ND designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors SD and ND managed the analyses of the study. Author SD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Human-Wildlife Conflict (HWC) is one of the most unavoidable challenges to be faced in the era of rapid development. The reason for the human and wildlife interaction is mainly the sharing of resources and the intervention of humans in the wildlife habitats which has resulted in habitat degradation. The present study was carried out in the arid landscape of Gujarat in order to understand the impact of crop damage by wildlife and to know the perception of locals towards the wildlife. One hundred and fifty (150) successful interviews were conducted from ten villages located on the fringe of the Greater Rann of Kachchh, in Banaskatha district using a structured questionnaire. The results shows that the mean area of land available per household is 10.5 ± 7.8 acre with the mean annual income of $ 460 ± 197. It was calculated that the respondents were at loss of $ 318.5, due to crop damage annually. Besides wildlife, water scarcity and natural calamities are other major constraints to the farmers of this area. Wild boar *(Sus scrofa)* is reported as the major wild animal responsible for crop damage, followed by blue bull (*Boselaphus tragocamelus*) and wildass (*Equus hemionus khur*). As a result, 70% of the respondents reported unwillingness towards coexistence. Farmers here are implementing both traditional and modern preventive measures to control the crop damage. The study revealed that those who have more land are more likely to lean towards modern preventive techniques which have no significant influence by the income of the farmers. The study suggests that fencing of farm and removal of pest species may be act as important measures to mitigate the conflicts in this region. However, provision of adequate and timely

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compensation by the authorities to the farmers for crop damage may help to generate the benevolence among the locals.

Keywords: Crop depredation; wildass; desert of kachchh; human-wildlife conflicts; community perception; Chinkara.

1. INTRODUCTION

Human-Wildlife Conflict (HWC) is a major issue to tackle which undermines the basic idea of conservation [1,2]. Hence, it has caught the attention of many ecologists, conservationists and policy makers [3,2]. Anyway, the presence of wildlife is always a threat to the lives of mankind especially in areas where the niche of both human and wildlife overlaps [4]. This leads to continuous conflicts between man and wildlife [5,6]. Destruction and conversion of forests to agricultural and pastoral grounds is one of the reasons for infiltration of wildlife into human inhabitations for food, water and shelter [4]. HWC is always a headline issue but never new to conservational studies. A study around Nile delta reveals that animals like hippopotamus (*Hippopotamus amphibius*), crocodiles (*Crocodylus niloticus*), and elephants (*Loxodonta africana*) were also a part of Human-wildlife conflicts [7]. Apart from the fundamental factors such as food, water and space; there are some other factors such as change in LULC (Land Use Land Change), deforestation, climate change, zoonotic diseases and over population [8,9,10], ignorance about wildlife [11], insufficient compensation [12,13], non-participation of communities in conservational efforts [14], decrease in availability of food for wildlife and increase in number of ungulates [15,8,16,17] are important to study and address. The consequences of HWC are broadly classified into direct (injuries or loss of life of both human and wildlife, livestock depredation), and indirect (household damage and crop depredation) conflicts; loss due to indirect conflicts are often difficult to assess than the direct losses [18,2]. Crop damage is the major cause of such indirect conflict in most of the cases reported from different parts of the world [19,20,21,22,23,13]. Crops are rich in nutritional value and easily available and hence are highly vulnerable to be depredated by wildlife [24,25,26]. The resulting consequences leave a negative perception towards wildlife among the local communities and form a base for retaliatory killings of wild animals posing threat to conservation [27,28,29]. Retaliatory killings are common in developing countries than the developed ones because of the socio-economic differences of the local people [30,31,32]. Lack of apt information regarding conflicts influence us towards relying on wrong decisions and ultimately result in unpredicted outcomes [33]. Cultural, social, economic, and demographic status of the people play a very important role in framing the perception and attitude towards wildlife [34]. Even, the extent of the damage varies according to the species, area, behavior, season, and time of the conflict involved [1]. Protected areas are the most studied zones of conflict with wild animals often encountering human inhabitations in search of basic needs [9,2,4,6]. However, there is a dearth of scientific data and information from the non-protected, non-forest and the urban areas.

In the present study, different species of wild animals involved in crop damage, local people' perception towards them and the crop protection techniques being adopted by farmers are studied exclusively. The results of the study help in framing mitigation measures at the policy level. The study area chosen for the study is not much explored from HWC point of view and would address the conservation goals for the future. People here are mostly farmers and pastoralists who often encounter wildlife. The study of their perception will help in developing a rational design for effective mitigation strategies [35]. From the literature review and pilot study, it was noted that the study area is diverse with wildboar (*Sus Scrofa*), blue bull (*Boselaphus tragocamelus*), Wildass (*Equus hemionus khur*), and Chinkara (*Gazalla bennittii)* which are responsible for crop damage there [4,15,36]. The study is designed to assess the socio-economic condition of the people, crop damage incurred, their perception towards wildlife, and preventive measures for minimizing crop depredation. We have also assessed the economic losses due to crop depredation that may help in figuring out the potential solutions for encouraging human and wildlife co-existence.

2. METHODOLOGY

The study was conducted in the villages located on the fringe of the desert of Kachchh in Banaskantha district of Gujarat. Ten such villages were selected after a pilot survey (Table 1). The Banaskatha district is located in the northern part of Gujarat state and encompasses an area of 12703 $km^{2.}$ Banaskantha (Fig. 1), named after the river Banas which runs through the valley between Mount Abu and the western Aravallis. It flows through the plains of Banaskantha region and towards the Rann of Kachchh in its course. The Rann (Saline and sandy desert) in the west forms a different landscape in which a few isolated uplands

(bets) are inhabited. It has a brackish environment that harbours variety of fauna and flora. The district shares state borders with Rajasthan of India in the north and international border with Pakistan in the west. The land of Banaskantha is mostly semi-arid type and the elevation of district ranges from less than 10m in the western part to 800m in the north-eastern part. The climatic pattern is diverse with extreme temperature, erratic rainfall, and high evaporation (Gupta, 2011). The livelihood of most of the people here is agropastoralism, whereas, some people migrated to the other parts of the state for private jobs. Due to water scarcity, farmers have only two farming seasons: pre-monsoon and post-monsoon. With fewer rainy days, the annual mean rainfall is around 160 to 200mm. Temperature may rise up to 45^0C in peak summers and also may drop down to 4^0C in winters.

Table 1. Name of selected villages with their location

Sr. No	Name of Sub-district	Name of villages	Location
1	Suigam	Bhardava	24°13'41" N, 71°21'15" E
2	Suigam	Radosan	24°15'14" N, 71°19'17" E
3	Suigam	Pardon	24°17'35" N, 71°19'06" E
4	Vav	Asara	24°20'07" N, 71°23'25" E
5	Vav	Lodrani	24°25'43" N, 71°23'02" E
6	Vav	Rachhena	24°27'04" N, 71°22'49" E
7	Vav	Chothanesda	24°29'43" N, 71°23'28" E
8	Vav	Chandangadh	24°30'46" N, 71°23'06" E
9	Vav	Radhanesda	24°33'03" N, 71°18'19" E
10	Vav	Mavsari	24°36'52" N, 71°22'07" E

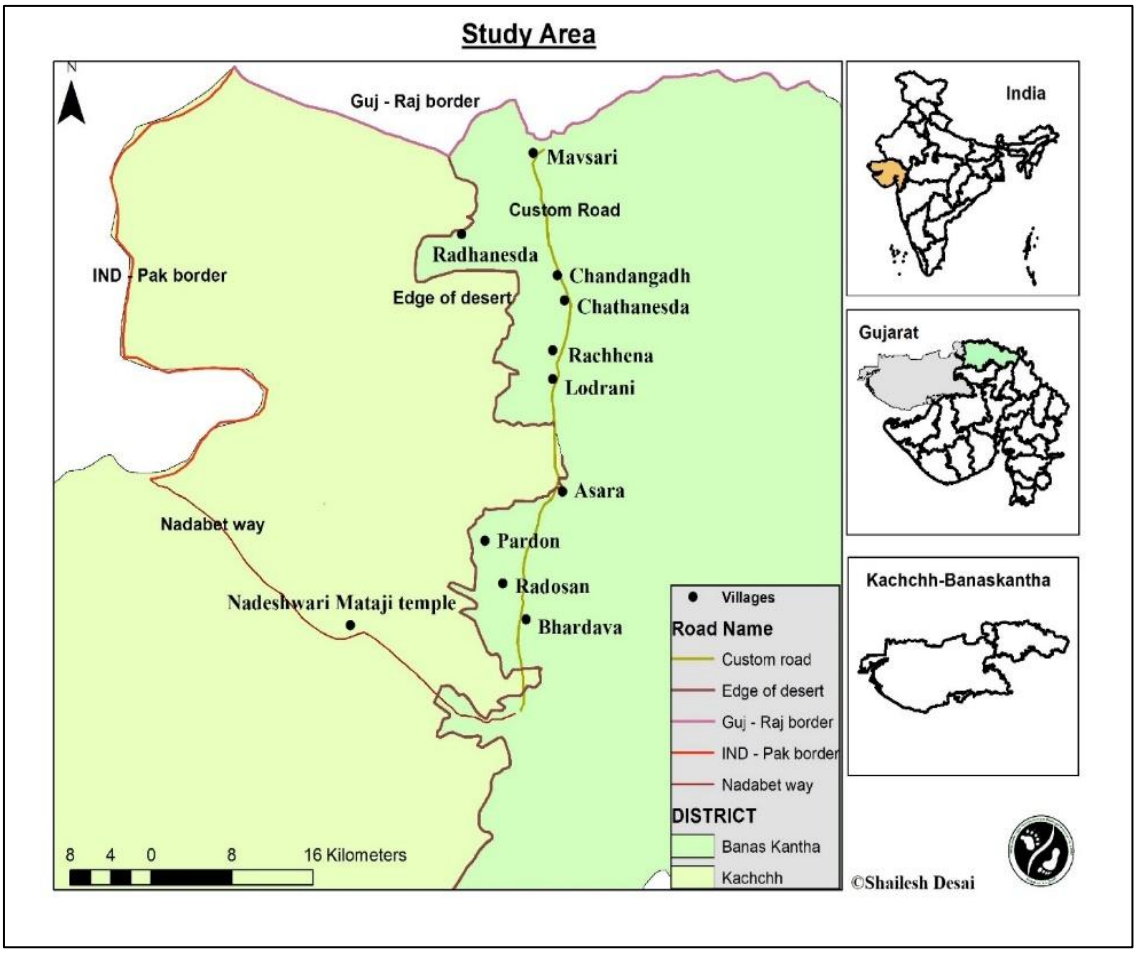

Fig. 1. Map showing the study area within the district of Banaskatha

2.1 Data Collection and Analyses

A structured questionnaire was prepared as per the objectives of the study. The data was collected through interaction with the respondents in their local language (Gujarati). In case, the respondents didn't understand the question properly, it was explained in full detail by the interviewer to get a more precise answer. Before taking the survey, the respondents were made sure about the study and their consent was taken in the form of verbal approval. They were informed that the information obtained through the study would be used for research and educational purposes and they were assured that their name and personal details will not be disclosed at any time. Randomly fifteen farmers were selected from each village, and a total of 150 individuals were interviewed from ten villages. The survey was started and completed between the months of November and January 2019-20.

The questionnaire contains the questions, mainly about the farm area, farming practice, crop, cropping pattern and the details of wild animals that visit and raid their farm. Questions about different wild animals seen in that area, intensity of crop raids and crop damage by different species, their perception towards co-existence with wildlife and suggestions for conservation and sustainable use of resources were asked and answers were noted in details. The crop protection techniques implemented by the local farmers for different species of wild animals were also studied and observed during the farm visit. The questionnaire was prepared with specific questions like which method is implemented, how it works, cost involved, and species-specific methods. The role of government in crop protection, timely compensation, constraints for implementing various protection methods and the extent of loss incurred were also studied. To avoid the chance of over-reporting and exaggeration by the respondents, only individual responses were collected avoiding the group interviews. It was made clear to the respondents that this is just a part of the study and not a survey to provide any compensation. For further analysis, all the data collected were entered in a preformatted MS Excel® datasheet (MS Office, 2016). Most of the analysis was done by MS Excel and Statistical Package for Social Science (SPSS V25, 2017) with a 95% significant value.

3. RESULTS

3.1 Socio-economic Characteristic of the Respondents in the Study Areas

Perception of a community towards wildlife is often affected by their socio-economic conditions. All the respondents are involved in the agropastoralism, of which 95% were male. Most of them were between the ages of 18 to 80 years with the mean age of 48.6 ± 12.4and mean of family size as 5.9 ± 2.6 (n=150). The mean area of land available per household is 10.5 ± 7.8 acres (n=146), and the mean annual income is $ 460 ± 197. Apparently, only about 63.3% of respondents were farming in both seasons (pre-monsoon and post-monsoon).

3.2 Perception towards Animals

Studying the perception of the local community plays a vital role in conservation. Among all the respondents only 18% and 6.6% of the respondents like Wildass (*Equus hemionus khur)* and Chinkara (*Gazalla bennittii)* respectively, whereas 58.6% do not appreciate the presence of any wildlife in their surroundings whereas 16.6% of respondents refused to answer this question. When asked specifically about the most disliked species, 68% were voted for wild boar (*Sus scrofa)*, 1.33% for blue bull (*Boselaphus tragocamelus)*, 22% were equally voted their dislike for both wildboar and bluebull and 8% of them said that they do not like the presence of wildass. Overall, the results depict the hostility of the local community towards the wildlife in general, and wildboar (*S. Scrofa)* and bluebull *(B. tragocamelus*) in specific. According to the ranking given by the respondents to the most notorious species, the wildboar (*S. scrofa*), bluebull (*B. tragocamelus*) and the wildass (*E. hemionus khur*) are among the top ranked species followed by the chinkara (*G. bennittii)* (Table 1). Besides, respondents claimed that they lost an average of $ 318.5 per annum per respondent just due to crop damage by wildlife. However, there is no any significant difference between the two groups (df=148, p= 0.181>0.005), who ranked wild boar (*S. scrofa*) or blue bull (*B. tragocamelus*) as a top vermin species in their surroundings.

The results show that almost half of the respondents wished wild boar is excluded from the area, 7.3% do not agree with the presence of blue bull, and 40% of the respondents insisted to remove both wild boar and blue bull. Among the respondents,63.3% were doing farming in both seasons. 89.2% of respondents believe that more damage occurs in post-monsoon season than pre-monsoon. While asking for coexistence, only 25% of respondents showed willingness for co-existence with some conditions. Wildlife in this area is considered as a major constraint for better crop yield as 44.7% of respondents agree with this statement; whereas 36.7% and 18.7% of respondents believed water scarcity and natural calamity respectively were the major constraints for crop yield. The stage of the crop which

Table 2. Wild animals involved in crop damage in the study area ranked by the respondents (n=150)

Species	# Respondents Ranked 1	#Respondents Ranked 2	# Respondents Ranked 3	# Respondents Ranked 4
Wild boar	128	22	0	0
Blue bull	21	127	2	0
Wildass	1	1	45	0
Chinkara	0	0	0	7

is more vulnerable for depredation is also investigated through this study. The respondents said that, wild boar (n=147) and blue bull (n=13) damage the crops at all the stages (sowing, premature and mature, harvesting), while wildass and chinkara were reported to feed on the premature and mature crop.

3.3 Prevention Methods

Farmers of this area are using various methods to prevent crop damage and to keep wildlife away from their farms. For the convenience of study, these methods are divided into traditional and modern methods. Among traditional methods; group guarding, guarding with a dog or without a dog, scarecrows, "machans", "Gophan", and biological fences were more commonly observed; while among the modern methods, electric fencing and barbed wires were used. The preventive methods used by the farmers are influenced by the total land area; significantly at 99% (df= 144, p= 0.0003) but it does not influence the income of respondents (df= 144, p= 0.53).

Table 3. Types of crop damage prevention methods adopted by the respondents in the study area

Prevention method	#Respondents (n=150)
Traditional methods	
i) Guarding with dog	97
ii) Guarding without dog	53
iii) Scarecrows	140
iv) Gophan	77
Advance methods	
I. Electric fencing	36
II. Barbed wire	9

4. DISCUSSION

Agropastoralism is a main source of livelihood of most of the respondents. In the survey, 95% of respondents were males who were more involved in the farming activities; However, females are not allowed to speak with a stranger in the presence of head of the house. More than a half of the respondents are owning the land of less than 10 acres with the annual income of around 468 $. The annual income of the farmers in the study area is less than 70% compared to the per capita income of the country which is 2006 $ (World Bank, 2018). Compared to the mean land size, the income is very low, indicating some constraints to the crop yield, among which crop depredation by wildlife, water scarcity and natural calamities can be few of them. According to many respondents, crop damage by wildlife can be minimized with effective measures unlike poor yield by water scarcity and natural calamities which cannot be manually controlled. Poor yield due to water scarcity is the major obstacle for sustainable livelihood in the entire region. Besides water scarcity, this region is located at a lower sea level (around 20 to 30m) thus creating a huge difference in the inflow of water and resulting infrequent floods. In the years 2015 and 2017, floods caused huge damage to human life and property. Further, in 2019, Desert locust (*Schistocera gregaria*) attack in a group of millions and millions resulted in huge crop loss to the farmers [37]. Besides, respondents claimed that they bear losses up to an average of 318$ per person due to crop damage by wildlife. It is almost more than 60% of their annual income and emerged as the main reason for their negative attitude towards wildlife, hence only a few people found positive and agree to develop a coexistence with wild animal like wild ass and chinkara, because of their endemism to that area. They are emotionally attached to wildass and chinkara. Although, chinkara generally do not prefer living in the vicinity of agricultural areas [38]. Half (50%) of the respondents wanted wild boar (*S. scrofa)* and blue bull (*B. tragocamelus)* to be removed from their area, because wild boar (*S. scrofa)* was said to cause damage to all the phonologies of crop from sowing to harvesting stages, whereas, blue bull (*B. tragocamelus)*, wild ass (*Equus hemionus khur)*, chinkara (*G. bennittii)*, caused damage at the premature stage of the crop. It is important to study the stages of crop damage to assess the loss because an early-stage crop damage can be recouped as the plant has the ability to regrow which may not be the case of late-stage crop damage [39].

Group discussion with the local community revealed that blue bull (*B. tragocamelus)* cause damage to the field even when they trespass, as they mostly move in a group. Wild boar *(S. scrofa)*, apart from damaging the crop by eating, also increase the extent by wallowing, moving, and trampling the fields [40].

Wild boar *(S. scrofa)* nests were also seen in the fields. They prefer grain or seed thus causing substantial damage during sowing and harvesting stages. Wildlife mostly raids the crop during nights to avoid human confrontation. Due to successful conservation efforts of wildass, their population has increased, thus increasing the crop raiding losses too [15,36]. Owing to that few respondents has perceived wildass as notorious species. Crop damage by wildlife threaten the food and livelihood security of these local people thus becoming a hindrance to their nutritional supplementation and a reason to their negative perception and hostility towards wildlife [2,41]. Loss due to wildlife is insignificant at the national level but it is a burden to the families being affected [42]. Besides crop loss, injuries due to wild boar [43], economic loss, and opportunity loss shape their perception negatively. Only 25% of respondents showed their willingness to co-exist with due demands and recommendations for full-fledged cooperation and compensation from the government. Some of them requested for help in preventing wildlife damage through barbed fencing and other mechanisms. Some demand compensation for their loss, whereas few others demand for licensed arms to shoot wild boar *(S. scrofa)* and blue bull (*B. tragocamelus)*. Some respondents suggested for translocation of wildass (*Equus hemionus khur)*, and denying to co-exist. Like our case, farmers in some countries like Kenya and Nepal started leaving their cultivable lands which were vulnerable to crop raids by wildlife [39,44]. It depicts that, there is an urgent need to develop efficient mitigation measures to build positive attitude among such farmer communities towards the wildlife. The perception of people here is not influenced by the land size and income unlike in developed countries. Tanner and Dimmick, [45], studied that high-income people tend to less tolerate wildlife damage. Crop damage in this area is equal among all classes of people. The higher crop damage activities by wildlife in post monsoon season due to the decline in natural sources of food and water forcing the animals for crop raiding in groups [16]. Respondents who perceived that pre-monsoon damage is high stated waterlogging in the desert as a reason [15].

We found that farmers were using multiple methods, to prevent crop damage [31,4]. Cost-effective traditional methods like guarding with the help a dog or without dog, using scarecrow, and group guarding was common. Some farmers were using audio or video tapes as a reflector to keep the wildlife away [9]. Farmers even use their old clothes to make statutes or scarecrows, to create an artefact of a man present on farm. With time, this method seemed less effective as the wild animals got habituated and continued raiding indiscriminately. Besides all these methods, some farmers use stones and utensils to produce noise that instigate fear among animals. They use "Gophan" specially designed to shoo away birds. Most farmers sleep on the raised platforms called "Machans" which aids in observing the entire field and also in protecting themselves from wildlife attacks [32]. Farmers also use biological fencing of *Euphorbia neriifolia* (Thor) and branches of *Prosopis julifera* [46] to fence their fields. Fences of wooden poles and thorny branches which are looped around the field are or cut from the nearby forest can cause irreversible damage to local plants and trees [47]. Only 45 of the total respondents were using modern methods which was largely influenced by the land size (significant at 99%, df= 144, p=.0003), but not by the income of respondents (df= 144, p= 0.53). This indicates that the modern methods are highly preferred when the area of land is more. We found that those who have a minimum 12-acre land size are likely to use adopted methods. As in other studies too, if the land size and income are high, people tend to use modern methods which are expensive and likely to tolerate damage [45,48]. Income of a house always shape the future of the household. Loss of income affects their children's education, health, food, and future needs. Hence to increase the tolerance level of people, compensation and insurance schemes should be implemented and the same should be updated from time to time. Local community should be involved in conserving the remaining population of wolf [49], which in turn control the number of ungulates and thus help in reducing the damage. However, there is a need to amend the law and frame species-specific guidelines for measuring and mitigating conflicts and thereby aid in crop protection. Implementing awareness and education programs among the locals could play a key role in mitigating the conflict and helping in conservation efforts. Developing a Corporate-Government Model with the help of local NGOs, Institutions and companies CSR would generate a greater positivity among the local people. This model may include, crop protection techniques, awareness programs, change in cropping systems, use of the modern farming practices, insurance etc, this will help to raise the income and compensate the economic loss to an extent.

5. CONCLUSION

Crop damage by wildlife is a serious concern of the local community here, water scarcity and natural calamities are other added load to the farmers of this region. Wild boar *(S. scrofa)* and Blue Bull (*B. tragocamelus)* are perceived to be the species responsible for crop damage and also causing injuries to people and damaging the infrastructure to a greater

extent. The recent increase in the Wildass (*Equus hemionus khur)* population may emerge as another problematic species and can hamper the conservation of this endemic species of Gujarat. Most of the people here are reluctant to co-exist with the wildlife. Local community also need to conserve the leftover population of wolf which regulates the population of Blue Bull and wildboar. People here are in great need of government support for compensating their losses and in implementing effective prevention measures to mitigate conflict and increase their tolerance level. This study can be used as a base for long-term research on similar aspects and seasonal field survey to quantify crop damage through crop depredation, which can help the policy makers. This study also reveals the perception of locals toward wildlife and the cost they pay to live with them.

CONSENT

Interviews were conducted following written consent of each respondent.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Barua M, Bhagwat SA, Jadhav S. The hidden dimensions of human-wildlife conflict: Health impacts, opportunity and transaction costs. Biological Conservation. 2013;157:309-316.
2. Nyirenda VR, Myburgh WJ, Reilly BK, Phiri AI, Chabwela HN. Wildlife crop damage valuation and conservation: Conflicting perception by local farmers in the Luangwa Valley, eastern Zambia. International Journal of Biodiversity and Conservation. 2013;5(11): 741–750.
3. Messmer TA. The emergence of human-wildlife conflict management: Turning challenges into opportunities. International Biodeterioration and Biodegradation, 2000; 45(3–4):97–102.
4. Dharaiya N. Evaluating habitat and human sloth bear conflicts in north Gujarat India, to seek solution for human- bear coexistences. Research project report1 submitted to the small grant's division, Rufford foundation, London, England, UK; 2009.
5. Zimmermann A, Baker N, Inskip C, Linnell JDC, Marchini S, Odden J, Rasmussen G, Treves A. Of human – carnivore conflicts on wild rangelands. Wild Rangelands: Conserving Wildlife While Maintaining Livestock in Semi-Arid Ecosystems. 2010;129–151.
6. Manfredo MJ, Dayer AA. Concepts for exploring the social aspects of Human–Wildlife conflict in a global context. Human Dimensions of Wildlife. 2004;9(4):1–20.
7. Barnes RFW. The conflicts between humans and elephants in central African forests. Mammal's Review. 1996;26(2):67-80.
8. Vijayan S, Pati BP. Impact of changing cropping pattern on man-animal conflicts around Gir P.A. with specific reference to Talala Taluka. Indian Forester. 2001;127(10): 1121–1133.
9. Meena RP, Meena BL, Nandal U, Meena CL. Indigenous measures developed by farmers to curb the menace of blue bull (*Boselaphus tragocamelus)* in district Rajsamand, Rajasthan, India. Indian Journal of Traditional Knowledge. 2013;13(1):208–215.
10. Singh BB, Gajadhar AA. Role of India's wildlife in the emergence and reemergence of zoonotic pathogens, risk factors and public health implications, Acta Tropical. 2014;138: 67-77.
11. Sitati Noah W, Walpole MJ. Assessing farm-based measures for mitigating human-elephant conflict in Transmara District, Kenya. Oryx. 2006;40(3):279– 286.
12. Dixon JA, Sherman PB. Economic of protected areas: new look at benefits and costs. Island press, Washington, D.C; 1990.
13. Patel, Dharaiya. Human-wildlife conflicts in arid areas of Western India: Strategies for mutual co-existence. Ambient Science. 2014; 1(1):29–37.
14. Zimmerer Karl. Cultural ecology; at the interface with political ecology- the new geographies of environmental conservation and globalization. Sage Journals. 2006;30(1):63-78.
15. Dave CV. Understanding conflicts and conservation of Indian wild ass around Little Rann of Kachchh, Gujarat, India. Research project report1 submitted to the small grant's division, Rufford foundation, London, England, UK. 2009;39.
16. Chhangani AK, Robbins P, Mohnot SM. Crop raiding and livestock predation at Kumbhalgarh wildlife sanctuary, Rajasthan India. Human Dimensions of Wildlife. 2008;13(5):305–316.
17. Meena M. Agriculture crop damage by antelope (*Boselaphus tragocamelus*) and management strategies: Challenges in India. International Journal of Zoology Studies. 2017; 2(6):157–160.
18. Hoare R. A decision support system for managing human–elephant conflict situations

in Africa, Nairobi, Kenya: IUCN/SSCA African Elephant Specialist Group; 2001.

19. Kiss A. Living with wildlife: wildlife resource problems management with local participation in Africa. World approaches based on the establishment of transparent, Bank Technical Paper, 130. World Bank, Washington, DC, USA; 1990.
20. West PC, Brechin SR. (Ed.). Resident peoples and national parks. University of Arizona Press, Tucson, Arizona, USA. 1991;xxiv:443.
21. Schultz BO. The management of crop damage by wild animals. Indian Forester. 1986; 112(10):891–899.
22. Heinen JT. Park-people relations in Kosi Tappu Wildlife Reserve, Nepal: A Socio-economic Analysis. Environmental Conservation, 1993; 20(1):25–34.
23. Madhusudan MD. Living amidst large wildlife: Livestock and crop depredation by large mammals in the interior villages of Bhadra Tiger Reserve, south India. Environmental Management. 2003;31(4):466–475.
24. Chiyo PI, Cochrane EP, Naughton L, Basuta GI. Temporal patterns of crop raiding by elephants: A response to changes in forage quality or crop availability? African Journal of Ecology. 2005;43(1):48–55.
25. Rode KD, Chiyo PI, Chapman CA, McDowell LR. Nutritional ecology of elephants in Kibale National Park, Uganda, and its relationship with crop-raiding behavior. J Trop Ecol. 2006; 22:441.
26. Gordon IJ. What is the Future for Wild, Large Herbivores in Human Modified Agricultural Landscapes? Wildlife Biology. 2009;15(1):1–9.
27. Naughton-Treves L, Treves A. Socio-ecological factors shaping local support for wildlife: crop-raiding by elephants and other wildlife in Africa. People and Wildlife. 2009; 2014:252–277.
28. Karanth K, Naughton-Treves L, DeFries R, Gopalaswamy A. Living with wildlife and mitigating conflicts around three Indian protected areas. Environmental Management. 2013;52(6):1320–32.
29. Bayani A, Tiwade D, Dongre A, Dongre AP, Phatak R, Watve M. Assessment of crop damage by protected wild mammalian herbivores on the western boundary of Tadoba-Andhari Tiger reserve (TATR), Central India. PLoS ONE. 2016;11(4):15–19.
30. Linkie M, Dinata Y, Nofrianto A, Leader-Williams N. Patterns and perceptions of wildlife crop raiding in and around KerinciSeblat National Park, Sumatra. Animal Conservation. 2007;10(1):127–135.
31. Shekhar N. Crop and livestock depredation caused by wild animals in protected areas; the case of sariska tiger reserve, Rajasthan, India. Environmental conservation. 1998;25(2):160-171.
32. Rao KS, Maikhuri RK, Nautiyal S, Saxena KG. Crop damage and livestock depredation by wildlife: A case study from Nanda Devi Biosphere Reserve, India. Journal of Environmental Management. 2002;66(3):317–327.
33. Conover MR, Butikofer E, Decker DJ. Wildlife damage to crops: Perceptions of agricultural and wildlife leaders in 1957, 1987, and 2017. Wildlife Society Bulletin. 2018;42(4):551–558.
34. Ite DUE. Community perceptions of the Cross River National Park, Nigeria. Environmental Conservation. 1996;23(4):351–357.
35. Senthilkumar K, Mathialagan P, Manivannan C, Jayathangaraj MG, Gomathinayagam S. A study on the tolerance level of farmers toward human-wildlife conflict in the forest buffer zones of Tamil Nadu. Veterinary World. 2016; 9(7):747–752.
36. Suthar Ashok, Ketan Tatu, Kamboj RD. Status of grasses and sedges used as main natural food plants by Indian wild ass in the fringe areas of little Rann of Kachchh (LRK), Gujarat, India. International Research Journal of Biological Science. 2018;7(5):28-31.
37. Joshi MJ, Raj VP, Solanki BC, Birari VV. Desert locust (*Schistocera gregaria*) outbreak in Gujarat (India). Agriculture & food: E-Newsletter. 2020;2(6):691-693.
38. Goyal SP, Bohra HC, Ghosh PK. Ecology of water holes and seasonal changes in fecal constituent in free- ranging Indian antelope (*Antelope cervicapra*) and the Gazelle (*Gazella gazelle*. Geobios. 1985;12 (Spl. Issue):279-284.
39. Sitati NW, Walpole MJ, Smith RJ, Leader-Williams N. Predicting spatial aspects of human-elephant conflict. Journal of Applied Ecology. 2003;40(4):667– 677.
40. Brooks JE, Ahmad E, Ahmad E, Khan MH. The agricultural importance of the wild boar (*Sus scrofa* L.) in Pakistan. Tropical Pest Management. 1989;35(3):278–281.
41. Gontse K, Mbaiwa JE, Thakadu OT. Effects of wildlife crop raiding on the livelihoods of arable farmers in Khumaga, Boteti sub-district, Botswana. Development Southern Africa. 2018;35(6):791–802.

42. Kansky R, Kidd M, Knight AT. Meta-analysis of attitudes toward damage-causing mammalian wildlife. Conservation Biology 2014; 28(4):924–38.
43. Chauhan NPS, Barwal KS, Kumar D. Human-wild pig conflict in selected states in India and mitigation strategies. Acta Silvatica et Lignaria Hungarica. 2009;5:189–197.
44. Pandey S, Bajracharya SB. Crop protection and its effectiveness against wildlife: A case study of two villages of Shivapuri National Park, Nepal. Nepal Journal of Science and Technology. 2016;16(1):1–10.
45. Jhala YV. Damage to sorghum crop by blackbuck. International Journal of Pest Management. 1993;39(1):23–27.
46. Tanner G, Dimmick RW. An assessment of farmers' attitudes towards deer and deer damage in West Tennessee. Proceedings of the Eastern Wildlife Damage Control Conference. 1198;3:195-199.
47. Caughley G. Overpopulation. In 'Problems in Management of Locally Abundant Wild Mammals'. (Eds P. A. Jewell, S. Holt and D. Hart.) 1981b;7–19.
48. Messmer Ta. Human – wildlife conflicts: emerging challenges and opportunities. Society. 2009;3(1):10–17.
49. Jhala YV, Giles RH. The conservation and status of the wolf in Gujarat and Rajasthan, India. Conservation Biology. 1991;5(4):476–483.