Indian Journal of Animal Sciences **90** (7): 1201–1203, August 2020/Short communication

Estimation of losses to agricultural crops by the wild animals in Najibabad forest division

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Received: 3 January 2020; Accepted: 24 February 2020

Keywords: Agriculture, *Boselaphus tragocamelus*, *Elephas maximus,* Human wildlife conflict

Crop raiding by the wild animal is a serious issue all over India. It is more common in the areas adjacent to the forests or protected areas. It can also be defined as movement of wild animals from their natural habitat to the agricultural land to feed themselves by the crops that humans grow for their own consumption and trade (Zubiri and Laurenson 2001). The anthropogenic disturbances make this problem very serious. Various types of human wildlife conflict are found in our country but agriculture damage contributes as a major part due to direct economic losses.

In India, mammals like monkey, elephant, blue bulls (Nilgai) are considered as agriculture pests and the elephant is found to be the conflict causing animal in few specific areas. The conflict may not be direct but they raid crops which brings huge economic loss to farmers as they are dependent on their fields for their livelihood and earnings. The conflict is bi-dimensional as it affects the farmers and also the wildlife. The hills of Uttarakhand and terai (low elevation) areas of Uttar Pradesh are worst affected by negative activities of wild animals because of increasing anthropogenic pressures in these areas (Kukreti and Bhatt 2014).

In order to protect the crops from the wild animals, farmers spend time on techniques like fire, burning of crackers, gun shots. In this process, some wild animals damage their infrastructure and sometimes attack humans directly (Madhushudhan 2003). These conflicts develop the negative attitude of the farmers towards the wildlife which results into less tolerance towards the wildlife and sometimes leads to the attacks/injuries and killing of the wildlife (Conover and Decker 1991). In our country, the population of many wildlife species increased considerably while few of them have become locally over abundant after the implementation of Wildlife Protection Act 1972. These species have become serious pests of the agricultural crops and are competing for resource utilization with domestic stock. Outside India, a few studies have been conducted in Asia on the crop raiding by wildlife (Sekhar 1998, Rao *et al*. 2002). This paper presents study related to the crop raiding in various agro ecosystems like sugarcane, wheat and rice fields by wildlife.

Study area: To study and understand the issue of crop damage, 42 villages located within Najibabad forest division were identified and Najibabad forest division (29.63° N, 78.33° E) is located in Bijnor district (29.37° N, 78.13° E) of Uttar Pradesh. Western part of the Uttar Pradesh is known for its fertile soil thus high production of crops like sugarcane, rice, wheat and legumes. The forest division includes ranges namely Kauria, Badhapur, Sahuwala, Sahanpur, Rajgarh which are parts of three adminitrative blocks (Kotwali, Najibabad and some part of Afjalgarh). The Najibabad forest division covers an area of 390 km^2. The headquarters of the forest division is located at Najibabad. The northern side of the Najibabad forest division is attached to the Lansdowne forest division, while the eastern side is attached to the Corbett Tiger Reserve. Climate of the study area is warm and temperate with three seasons viz. rainy season (June to September), winter (October to February) and summer (March to May).

The assessment of crop damage was done by surveying the area/villages physically and by identifying the victims and each affected village was visited every week for the damage assessment during the study period. Crop fields affected due to crop damage were measured and the total area per range was also calculated from July 2015 to March 2018. We covered all agricultural land types with *rabi*, wheat (*Triticum aestivum*) and *kharif*, sugarcane (*Saccharum offcinarum*) and rice (*Oryza sativa*). The secondary information on agricultural damage was collected from the records of Najibabad Forest Division and later on these villages were surveyed to cross check the information as well as collect information on crop damage from different wildlife species.

Crop damage: During the study period, a total of 46.75 acres crops were found damaged by the wild animals. The highest damage [24.1 acre (51.5%)] was in the fields of sugarcane (*Saccharum officinarum*) across the study period

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Table 1. Forest range wise agricultural land damage

Range	Area in acre
Badhapur	22.8 (48.8%)
Sahuwala	10.6 (22.7%)
Kodia	5.9 (12.6%)
Sahanpur	3.7 (7.9%)
Rajgarh	3.6 (7.7%)

in comparison to rice (*Oryza sativa*) [10.5 acre (22.5%)], wheat (*Triticum aestivum*) [8.1 acre (17.3%)] and some vegetable crops [4 acre (8.5%)] such as potato (*Solanum tuberosum*), pea (*Pisum sativum*), cauliflower (*Brassica oleracea*) and cabbage (*Brassica oleracea*) etc. by wild ungulates (Table 1). The study revealed that the *kharif* crops were affected more in the study area as compared to *rabi* crops. During the *kharif* crop season, sugarcane is the major crop and this crop is the most preferred food for the elephant and hence more damage of *kharif* crops was observed during the study period.

Range wise agricultural damage: In all ranges, total crop damage was 46.75 acres. Badhapur Range was highly affected by human-wildlife conflict. It showed maximum loss of crops damaged by wildlife species than other forest ranges viz. Sahuwala, Kodia, Sahanpur and Rajgarh (Table 1) because the agricultural land in Badhapur range is surrounded by forests and hence the possibility of damage by wild animals was high in this range in comparison to other ranges.

For comparison of the damage caused by elephant, nilgai and wild boar in different ranges/study sites, one way ANOVA test was used considering the number of incidences of damage in each range.

The individual damage caused by elephants, nilgai and wild boar is given in Table 2.

Damage caused by elephant: Significant damage was caused by elephant in Sahuwala, Kodia and Badhapur ranges [P<0.008 (Sahuwala vs Rajgarh as controlled site), P<0.03 (Kodia vs Rajgarh), P<0.01 (Badhapur vs Rajgarh)].

Damage caused by nilgai: Significant damage was caused by nilgai in Badhapur, Sahuwala and Kodia ranges [(P<0.001 (Badhapur vs Rajgarh as controlled site), P<0.001 (Sahuwala vs Rajgarh), P<0.003 (Kodia vs Rajgarh)].

Damage caused by wild boar: Significant damage was caused by wild boar in Sahuwala and Badhapur ranges [(P<0.05 (Sahuwala vs Rajgarh as controlled site), P<0.01 (Sahuwala vs Rajgarh)].

In all the studied ranges, elephant was the most problematic animal. The most probable reason is that one side of Najibabad forest division (study area) is attached with Rajaji National park (famous for the elephant conservation) and other side is attached with the Corbett Tiger Reserve as a result of which there is frequent elephant movement and crop damage by wild animals.

Year wise crop damage: The area of crop damage increased during study period in the Najibabad forest division of Bjinor district (Table 3).

Table 2. Involvement of wild animals in crop damage individually

Wild animal	Damage area (acre)
Elephant	36.73 (78.7%)
Nilgai	7.4 (15.8%)
Wild boar	2.4 (5.1%)

Table 3. Year wise crop damage

Year	Crop damage (acre)
2013–14	3.75
2014–15	4.00
2015–16	12.1
2016–17	16.6
2017–18	17.9

During the study period, elephants were the most problematic animal for the crops of Najibabad forest division. The involvement of nilgai was also observed in agriculture damage on a small scale but until recently nilgai was considered as a major destroyer of crops especially to pulses but now the scenario has changed which may be due to illegal hunting of the species and only scattered population exists in these agricultural fields located in *terai* regions of Shivalik hills. The increased cases of crop raiding are not restricted to our study area only but also in all north western parts of India, the main reason for these types of conflicts is close forest boundaries with adjoining rural and urban areas with no proper fencing or rock wall to divide the forest from rural/urban areas. The elephants need to be given more attention by forest department about their movement and population, since they are continuously raiding the crops year after year and these conditions are helping to build a negative attitude towards them to avoid such conditions (Madhusudan 2003, Gubbi 2012, Karanth *et al.* 2013)

Compensation policy: For wheat and rice, the compensation was ₹ 2000 acre till 2009 and it was increased up to ₹ 2500/acre in 2010. It was also further increased in 2014 and set as minimum support price decided by government. State Government has taken steps to provide the compensation against damage to the farmers and also increased the rate of compensation for making the better relationship between farmers and wildlife. For sugarcane, the compensation provided by the government was ₹ 2500/ acre till 2009. It was increased to ₹ 3000/acre in 2010. After 2014, government changed its compensation policy and financial relief is provided as per minimum support price decided for different crops.

Human wildlife conflict can be controlled through diversification of crops, by shifting to legumes, pulses and rotation of *rabi* and *kharif* crops with medicinal plants and spices crops, which are less damaged by the wild animals. Solar electric fencing can work as a measure to prevent crop damage, it can be designed according to needs of

farmers and depending upon site-specific conditions as these fences are not harmful to the wild animals as well as farmers and they are easy to operate (Meena 2017). Government should ensure allocation of funds for timely payment of compensation to farmers and procedure should be made simple so that villagers find it easy to follow the required procedure to apply for compensation. Suggestion from farmers should be accepted to avoid these negative interactions with wild animals (Husain *et al.* 2018).

SUMMARY

The wild animals cause losses to agriculture crop yields. The present study focuses on the assessment of agricultural damage caused by these wild animals in villages adjacent to protected areas and located in Najibabad forest division in Bijnor (Uttar Pradesh). The results showed that elephant (*Elephas maximus*) is the most problematic animal responsible for crop raiding followed by nilgai (*Boselaphus tragocamelus*). The sugarcane fields closer to the forest edge are raided more by elephants in comparison to rice, wheat and vegetables. This study recommended that active participation of stakeholders with the help of forest officials can help in mitigating crop raiding incidences in future.

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