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## Challenges of hill farming due to crop-raiding by wild pigs in the Indian Himalayan region

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**The human societies living in the Himalayas are traditionally known for their symbiotic relationship with their surrounding ecosystem. With changing time and climatic conditions, this relationship is also transforming. One of the crucial examples of this transformation is the interaction between human and wild animals, that a few of the Himalayan villages have moved from 'co-sustenance' to 'conflict'. The agri-based villages situated adjoining the forest area are experiencing recurrent incidences of crop raiding by wild pigs. These raidings have emerged out as a noticeable threat to the existing agrobiodiversity of the area. Hence, plausible solutions to keep away the**

**crop raiders with special emphasis on the wild pigs are the need of the hour.**

**Keywords:** Agriculture, crop raiding, Himalayas, wild pig.

RECENT years have witnessed increasing incidences of human and wild animal conflicts, particularly in those villages that are neighbouring wilderness<sup>1,2</sup>. Reportedly, blackbuck in Gujarat has caused a loss of 48,600 kg of sorghum in a single season in two villages worth Rs 29,000 (US \$558)<sup>3</sup>. From carnivores like leopard and tiger that have wider habitat range to the smaller ones including wild pigs, porcupine, rabbits, mice and rats cause damage to human upon sudden encounters<sup>4-6</sup>. In the plains of Uttarakhand, other than wild pig (*Sus scrofa*), there are animals which damage crops like sambhar (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), cheetal (*Axis axis*) and elephant (*Elephas maximus*). Of these, wild pig and nilgai enter the fields which are farther from the forest<sup>7</sup>. A case study of Bilaspur district of Sutluj valley in the outer hills of the Himalaya depicted that the major menace for crop depredation was wild rhesus macaque, followed by wild pig and then rodents. The study also reported a considerable increase in weed population like *Anagallis arvensis* and *Lantana camara*<sup>8</sup>.

The Himalayan agro-ecosystems are vulnerable to man-animal interface that cause causalities as well as crop damage. In our efforts to reduce man-animal conflict, particularly in vulnerable areas, it is important to take stock of the site characteristics and human vulnerabilities and understand the dynamics and challenges in doing agriculture under exorbitant threats posed by the crop-raiders. We surveyed two villages in the forested neighbourhood of Almora district in Uttarakhand and documented the crop raiders and their impact on cropping systems.

The present study was carried out in two adjacent villages, Dantola (29°51.266'N and 79°22.962'E) and Mahatgaon (29°51.608'N and 79°22.507'E) of Kumaun Himalaya in the Almora district of Uttarakhand where the altitude ranges from 1010 to 1106 m. The region receives an annual rainfall of 862.8 mm. Agriculture is the backbone of the region, as more than 50% of the people are dependent on it for sustaining their livelihood. Total forest cover of the district is 1583 sq. km which is around 50% of the total area of the district (3144 sq. km), indicating the importance of forests in the lives of hill people<sup>9</sup>.

Both the villages are situated adjoining the forest area. Hence many wild animals like leopard, wild pigs, deer, fox, apes and monkeys are often found roaming in the villages. Leopard, deer and wild boar are generally seen at nights, while the monkeys and apes are abundant during day time in these villages. Fox are also seen any-time of the day. Villagers traditionally visit the forest to

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collect fuelwood, grasses and for livestock grazing, mainly the goats. All these make the villagers vulnerable to human-wildlife conflict.

The study area gets a good sunshine along with sufficient amount of rainfall all through the year<sup>10</sup>. However, water scarcity is reported during the summers (May-June). The available arable land is cultivated all around the year, both in *rabi* (October/November to April/May) and *kharif* (May/June to September/October) seasons. Major *rabi* crops are *Triticum aestivum* L., *Hordeum vulgare* L., *Lens culinaris* Medik., *Linum usitatissimum* L., *Brassica juncea* (L.) Czern. and Coss., *Brassica campestris* L., *Trifolium alexandrinum* L. Likewise, the major *kharif* crops are *Oryza sativa* L., *Eleusine coracana* (L.), *Sorghum vulgare* (L.) Pers., *Glycine max* (L.) Merr., *Vigna mungo* (L.) and *Macrotyloma uniflorum* (Lam.) verdc. The land is kept fallow for 15-20 days at the end of every cropping season. Apart from this, vegetables and spices are grown in the kitchen gardens. Major fruiting trees found in the village are mango, walnut, guava, pear and

litchi. A door-to-door survey was conducted in the village with the help of a structured and pre-tested questionnaire during 2017 and information regarding the crop raiding by wild-pig was gathered by covering 68% households (1 respondents from each house) from Dantola and 53% households (1 respondents from each house) from Mahatgaon village.

The agriculture in the study area is in transition state. Earlier, agriculture was fully traditional, but now-a-days farmers have started using chemical fertilizers, new crop varieties along with a shift from mixed cropping towards monocropping. The main reason for this shift is attributed to low productivity of the hill agro-ecosystem as they are ecologically challenged. In addition, ingress of wild animals and shortage of agricultural labours have also digressed the farmers from doing agriculture. While surveying the villages in the hill districts of Almora, Uttarakhnad, it was observed that wild pig (*Sus scrofa*) emerged as a major menace, as 70% of the villagers named it as crop raider (Figure 1). Apart from wild boar, deer, porcupine and mouse also raid the crops (cereals and vegetables). This, inadvertent scenario has stressed the farmers to an extent that income from agriculture is meagre and so is not a viable economic option anymore.

The aggression of wild pig is experienced in the crop fields throughout the crop cycle. The farmers revealed that when the crop is young, the wild pigs from the forested neighbourhood come and destroy the crops by tilling the soil using its teeth in search of food (Figure 2). When the crop is ready for harvest, these animals destroy the crop by eating the grains and also by random movement across the fields (Figure 3). Kumar *et al.*<sup>7</sup> found that the crop raiding by ungulates and wild elephants was higher during seedling stage in comparison to maturity stage. Wild pigs are known to injure or kill human beings in many of the Indian States in the past, out of which maximum casualties occurred in the forest (73.8%),

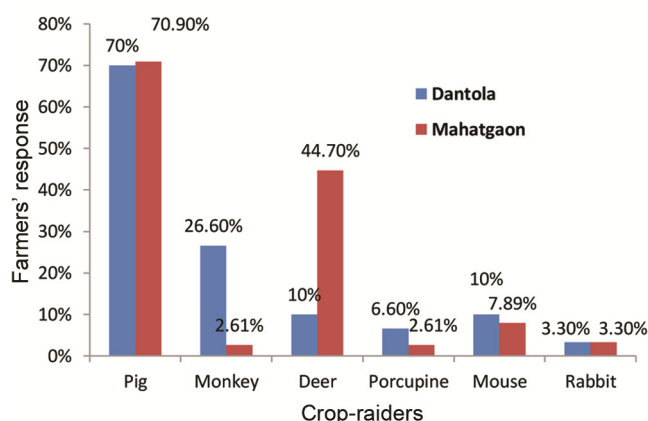


Figure 1. Farmers' perception on most damaging animals for crops.



Figure 2. Uprooted wheat crop by wild boar.



Figure 3. Crop raiding by wild boar during maturity stage of wheat crop.

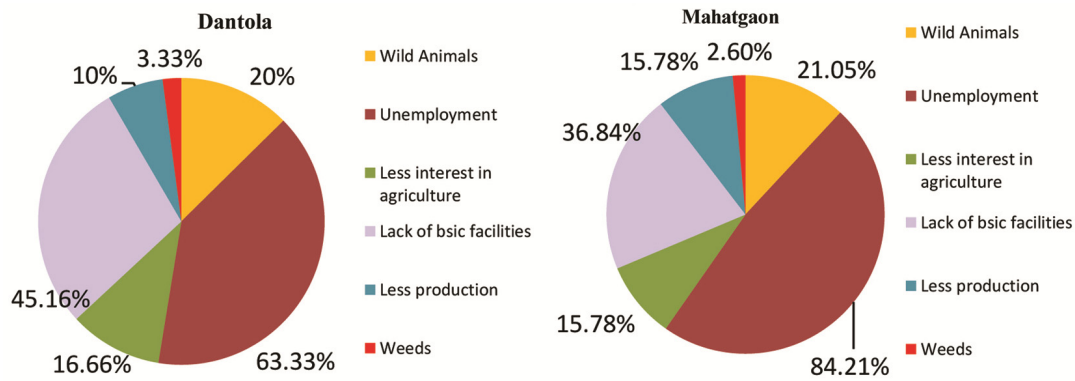


Figure 4. Causes of migration in the study villages.

Table 1. Crop species facing challenges according to the villagers

Crop species	Reason for decrease in area
Finger millet	Wild pig, lack of labour
Lentil	Wild pig
Garlic	Wild pigs, lack of water availability for irrigation
Onion	Wild pigs, lack of water availability for irrigation
Potato	Wild pig, porcupine
Ginger	Wild pig
Brinjal	Lack of water availability for irrigation, termite
Chilli	Porcupine (before fruiting)
Fenugreek	Porcupine
Barseem	Rabbit
Gram	Wild pigs
Maize	Wild pigs, fox
Capsicum	Lack of water availability for irrigation
Lady's finger	Lack of water availability for irrigation
Pea	Lack of water availability for irrigation, birds
Jowar	Birds
Cereals (wheat and paddy)	Field mice and rats, wild pig

followed by agriculture fields (21.7%) and a few in the villages (4.5%)<sup>2</sup>.

Another challenge in these villages is rodents like ‘field mice’ (*Mus* spp.) and ‘rats’ which cripple the matured crop particularly cereals, from the collar region and eat away the grains. In the kitchen gardens, porcupine is the major menace affecting the vegetable production system of particularly potato, young chilli and fenugreek plants. Apart from this, rabbit and deer also visit the crop fields occasionally and graze the green crop. This results in the reduction of cropped area as well as crop diversity (Table 1). Finger millet (madua) has higher nutritional content than rye, oats and barley and is a rich source of dietary fibre (18%), phyates (0.48%), protein (6–13%), minerals (2.5–3.5%), calcium (0.34%) and phenolics (0.3–3%)<sup>11</sup> was widely cultivated and consumed earlier in the area. However, due to crop raiding by wild pigs, the production declined and now only a few farmers are growing this crop. Crops like black sesame

(black til), amaranthus (chaulai), *Vigna angularis* (raiyan) and *Echinochloa frumentacea* (madira) have completely vanished from the cropping system of the villages, adding to the loss of agrobiodiversity in the Kumaun Himalaya.

Apart from crop raiding by wild animals, lack of employment opportunities and basic facilities has forced many villagers to abandon agriculture and migrate to towns and cities resulting in empty houses in the villages<sup>12</sup>. Currently, 18.18% of the households in the village of Dantola and 33% in Mahatgaon are empty. Migration being a substantial phenomena in the state, the economy of Uttarakhand is also called as ‘money order economy’<sup>13</sup>. Figure 4 indicates that the three important factors influencing migration are unemployment, lack of basic facilities (quality education, health and transport, etc.) and wild animals. Simultaneously, this has also led to the degradation of agrobiodiversity, because of which many landraces have been lost<sup>14,15</sup>. As a result, agriculture lands are left fallow, contributing to reduced production. Further, weed invasion is pronounced in the fallow lands. For example, *Lantana camara* has rampantly increased both in crop fields and forests<sup>16</sup>. Due to the invasion of weeds and bushes, these lands become solitary, which further provides shelter to the wilderness, thus harbouring the wild animals nearer to the village areas.

As the wild pig is a nocturnal animal, local people encounter these uninvited guests only after mid-night. Depending on seasonal variation, the wild pigs emerge out as early as 7–8 p.m. in the winters and 8–9 p.m. in the summers. They are seen roaming in the village paths and agricultural fields. Many studies have reported the causalities caused by wild pig to the mankind<sup>2,17,18</sup>. Nonetheless, the wild pig has become a major agricultural pest for villagers in the study area. As the wild pigs were observed to raid finger millet, potato, colocasia, lentil, etc., the local farmers have started growing these crops in a very limited area or restricted to the kitchen gardens,

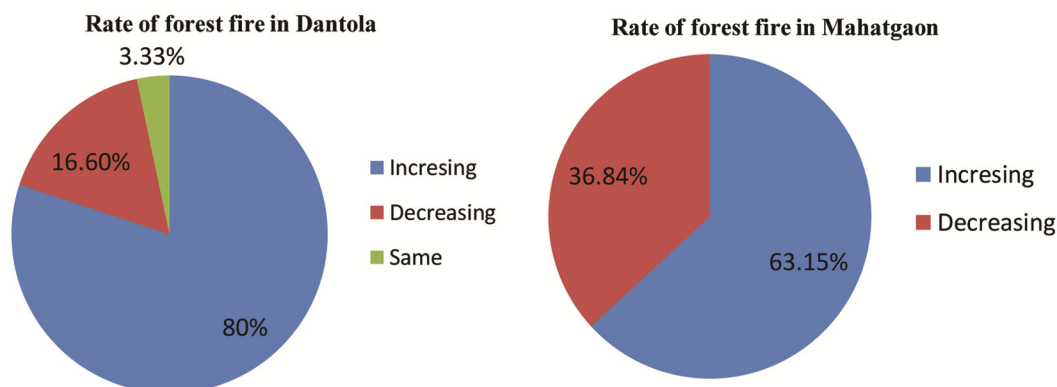


Figure 5. Peoples' perception about the rate of forest fire during the past few years in the study villages.

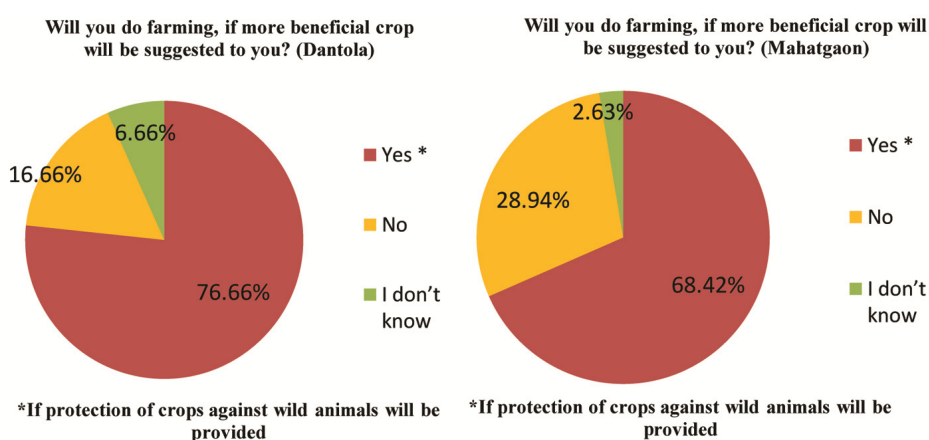


Figure 6. Peoples' perception regarding the introduction of more beneficial crop.

due to which these wild pigs have started feeding on other crops like soybean, bhatt (black soybean), paddy and wheat, etc. This poses a new and recurrent challenge for farmers as it affects the overall yield.

Earlier, people used to place scare-crows to repel animals and birds from the field. But now, this technique has also become useless, as the animals have developed resistance over it. The villagers also opined that in earlier days, the youth groups used to visit the fields at night for safe-guarding. Activities like beating drums and making scary noises were popular to repel the wild animals like boar, fox, leopard, etc. Presently, the percentage of youth is poor in the villages, as they all have migrated either for education or for better livelihoods. Nevertheless, the use of firecrackers is being adopted to scare away nocturnal animals and monkeys and apes during the day.

It was also observed that people used thorny bushes on the bunds of the crop fields like ber (*Ziziphus* sp.), kilmoda (*Berberis aristata*), hisalu (*Rubus ellipticus*), arandi (*Ricinus communis*), etc. all of which use to protect the fields from wild animals by acting like a natural barrier. Fruits of *Ricinus communis* are poisonous and were inten-

tionally grown to drive away wild animals<sup>19</sup>, besides its medicinal use by the villagers. These bushes also prevented soil erosion in terraces during the rains. Apart from this, a thorny tree, called *Pyrus pashia* (mehal) was also planted to keep away monkeys and apes from the field and to fence the susceptible crops<sup>20</sup>. Today, this traditional practice is lacking, as it could not be inherited naturally owing to education and enhanced human mobility away from the villages for income generation.

The villagers, particularly women, traditionally visit the neighbouring forest for grass, fuelwood and wild fruit collection. They used to cut the weeds and unwanted bushes in the forests that culturally facilitated the germination and growth of native flora, thus enabling the availability of feed resources in the wilderness. But today, a few villagers depend on the forest. Evidently, invasive weeds like *Lantana camara* flourished in the forest along with *Bauhinia vaheli* and other weeds<sup>21</sup> affecting the regeneration of native flora and create resource crunch for fodder, that eventually drove the wild animals towards villages. Further, dense weeds also make the site vulnerable to fire (Figure 5). It was observed that the

domestic livestock graze the vegetation in wilderness areas which makes the ecology of both ecosystems susceptible to weeds, as they carry over the seeds criss-cross, i.e. forest to cropfields and also from crop fields to forest.

In general, it was observed that villagers were not getting utilizable produce commensurating to their labour and other input. Around 16.66% of farmers in Dantola and 28.94% in Mahatgaon expressed less interest in pursuing agriculture, even if more beneficial cash crop was suggested to them. Nevertheless, there are 76.6% and 68.42% farmers in Dantola and Mahatgaon respectively, who still want to pursue agriculture (Figure 6). This warrants strategic provision for protection of their crops and crop fields. Hence, plausible solutions to keep crop raiders at bay with special emphasis on the wild pigs are the need of the hour.

Despite various challenges like migration, crop-raiding by wild animals and changing climatic conditions in the Himalayas, agriculture has been a source of livelihood sustenance for the mountain societies. Protection of crops from different crop raiders is very important to conserve the agrobiodiversity in the Himalayan region. In this regard, it is worth considering the revival of traditional methods of restraining crop-raiding by growing plants that forbid animal attention. Further, new economically viable crops need to be screened for introduction in these affected areas that could reduce crop-raiding incidences. As an economic-mitigation strategy, enabling crop insurance against crop failure due to wild animal will also help in neutralizing the crop loss to vulnerable communities of the mountain in order to retain these people in agriculture.

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