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## Does the loss due to Natural Disasters overshadow the loss due to Crop Raiding in Mountain Region? - A Case of Apple Producers from the Hills of Uttarakhand

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### ABSTRACT

As per the National Horticultural Board of India Apple (*Malus pumila*) is commercially the most important temperate fruit and is fourth among the most widely produced fruits in the world after banana, orange and grape. The states where apple mostly grows in India are all Himalayan States with the three North Western Himalayan States namely Himachal Pradesh, Jammu and Kashmir [undivided] and Uttarakhand contributing significantly in apple production. This study compares the loss in production of the horticultural crop 'apple' and its returns due to natural calamities and crop raiding by animals in the State of Uttarakhand. Both the phenomenon negatively affects the food security and indirectly results as a threat to the life and livelihood of mountain community. For this study Multistage Random Sampling method was used to collect the primary data from farmers (apple growers) through a pre tested schedule. Two sample independent test has been used to test the hypothesis. Results of the study show that the average losses in the apple production due to disaster and crop-raiding are approximately 939 kg and 488 kg per annum respectively in the study area. The average losses in the income of apple producers are almost rupees 34905 and rupees 14550 due to disaster and crop raiding respectively. Therefore the study shows that the loss in apple production and its returns are more due to natural calamities than crop-raiding by animals.

### 1. Introduction

Mountains are defined based on their elevation, altitude, and slope by the United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) (Huddlestone et al. 2003). The Mountain ecosystem is fragile in nature which varies with different climatic conditions depending upon the altitude, terrain, and location. The share of the mountain on the earth's surface is more than one-fifth of its total surface area with 12 percent of the world's population. Half of the mountain population lives in the region of Asia, Pacific (Huddlestone et al. 2003; Akramov, Yu, & Fan 2010). The fragile nature of mountains makes them vulnerable to natural calamities which negatively affects availability and accessibility of food (Huddlestone et al. 2003; Hofer 2005; Akramov et al. 2010). Due to the various factors like low productivity, subsistence farming and limitation of land, poor infrastructure, limited access to the market, and

high cost of production, the people living in mountain regions especially in developing countries are anticipated to be vulnerable to food security. Despite of these factors, the primary occupation of majority of the mountain people is agriculture and allied activities (Huddlestone et al. 2003; Ahmad et al. 2014). Thus life and livelihood of the mountain people largely revolves around agriculture, horticulture and allied activities.

The youngest mountains of the world are the Himalayan Mountains which are spread across the countries: Bhutan, China, India, Nepal, and Pakistan. They are active and fragile in nature which makes them vulnerable to the natural disaster. The geo-tectonic feature of the mountain makes it prone to landslides and earthquakes, and the diverse river system and monsoonal climate make it prone to floods and landslides (GOI, 2004; Varghese & Paul, 2013; Tianchi et al., 2001). The instability in climatic and geographical

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condition affects the livelihood of the people living in the mountain and can impact food insecurity and poverty. According to the Food and Agriculture Organization and other literature (FAO, 2015; Anh, 2016; FAO, 2017), agriculture and allied sectors constitute 22 to 23 percent of the total damage and losses incurred by developing countries due to disasters which implies that agriculture and allied sectors are significantly impacted by disaster and deserve more attention. Also, over the time, on one hand the increasing population is putting pressure on the demand of food, and on the other hand, crop-raiding by wild animals is creating an issue in achieving the goal of food security (Awasthi 2015). Human wildlife conflict (HWC) is the result of the growing human population and overlapping of the similar needs of both. Wild animals cause a great economic loss to the farmers by damaging their crops, livestock, and humans (Agrawal et al., 2016; Merkebu & Yazezew, 2021). The intervention of wildlife in agriculture acts as a great threat to the farmers who work hard throughout the year to grow the crops.

Uttarakhand is one of the hilly states of India with 86 percent of the hilly area and 14 percent of the plain region. The Himalayan ranges are the young fold mountains that covers the state's mountain region and is vulnerable to disaster (Sati, 2017). The vulnerability to the disaster along with its socio-economic condition makes it a disaster-prone state in the country (Tayal et al. 2015). Natural calamities like earthquakes, floods, hailstorms, cloudbursts, etc have been proved as major cause of loss to the region and society (Sharma et al. 2014). The state has more than 70 percent of its geographical area under forest (Yadav and Shalendra 2018) and 12 percent are protected areas according to the forest department of the Uttarakhand government. The state has agriculture as a chief source of livelihood with 70 percent of its population engaged in agriculture and allied activities (Sati 2005; Joshi et al. 2016) but have a huge dependency on the weather condition for crop production and returns. Also, based on literature it has been observed that many parts of Uttarakhand are facing the issue of wild animal conflict in human settlements which is destroying the crops of the farmer as well (Ogra 2008; Ksenjia 2011; Ogra & Badola 2015). The villages adjoining the forest areas of the state are mainly experiencing the issue due to wild animals (Pandey et al. 2019). Therefore, the study has been carried out in Uttarakhand which is among the major apple producing states in the country (Shaheen & Farhet 2000; Sheikh and Tripathi 2013; Minhas and Girish 2014). The study compares the returns and the losses due to disaster and crop-raiding in apple production in the state.

## 2. Material and Methods

The following Hypothesis were considered for the study

a) There is no significant difference in the mean of losses

in apple production due to disaster and crop-raiding by animals

b) There is no significant difference in the mean of losses in returns from apple production due to disaster and crop-raiding by animals.

Multistage Random Sampling was used in the study to collect the primary data from farmers (apple growers) with Uttarakhand apple farmers as the universe and Uttarkashi district was selected as the primary unit based on the production of apple in Uttarakhand and apple growers as the last unit.

In the First stage, the Uttarkashi district was selected based on the apple production in Uttarakhand. In the second stage, 2 blocks, Bhatwari and Naugaon were selected randomly out of the 4 major apple-producing blocks. The apple clusters in the block of Bhatwari and Naugaon are located in the hill region of Ganges valley and Yamuna valley respectively. In the third stage, 4 villages from each block were randomly chosen from the cluster, and then for the fourth stage, 10 farmers from each village were selected randomly.

The primary data has been used in the study with the pre-tested schedule. The study was conducted in the agriculture year 2019-2020 with a sample size of 80 apple producers. The statistical techniques like percentage, frequency, mean, and a parametric test i.e. 2 sample independent t-tests were used to analyze the primary data. The data was analyzed in MS Excel for the results.

## 3. Results and Discussions

### 3.1. Loss in Apple produce faced by growers due to disaster and crop raiding.

**Table 1.** Percentage of farmers who have encountered losses of produce due to disaster and crop-raiding.

Events	Yes	No
Disaster	91	09
Wild animal conflict	80	20

Table 1 reveals the percentage of apple growers who have encountered a loss in apple produce due to disaster and crop-raiding by animals. It shows that 91 percent of the farmers responded that they have faced disasters like flooding, landslides, excessive rainfall, etc whereas 80 percent of them reported the issue of crop-raiding in the apple orchards. The respondents reported that monkeys not only destroy their produce but also destroy the orchard of apple and make them of no use. The problems of wild boars in the apple orchards are also quite dominant. The growers reported that since apple trees are very delicate and takes long time in fruit bearing, they have to be raised very carefully and needs

much care but the intervention of wild boars are such that they completely destroy the trees. This poses huge loss to them. But since the wild animals do not destroy the whole orchard, partially they are saved. On the other hand in the case of natural disasters like cloudbursts, flashfloods etc either a large portion of the orchard gets destroyed or the fruits are completely destroyed. Moreover wild animals mostly affect the orchards in the fringes of the forest areas but natural disasters affect crops both near and far off from forest areas.

### 3.2. Comparing the mean of the apple production and losses due to disaster and crop-raiding

In the study, a 2 sample t-test is used to compare the losses due to disaster and crop-raiding. The result of table 2 showed that the p-value is 0.002 which is less than 0.05 which means it is statistically significant at a 5% level of significance and the first Null Hypothesis is rejected. The mean of the losses due to disaster 939 kg is almost double the losses due to crop raiding 488 kg. Therefore, it is observed that the impact of the disaster on the produce is almost double the impact of crop-raiding by wild animals in the study area.

**Table 2.** Comparison of losses of apple production (in kg) from disaster and crop-raiding

Two sample t-test		
	<i>Variable 1</i>	<i>Variable 2</i>
Mean	939.05	487.97
Variance	1312727.81	405149
Observations	73	64
Hypothesized Mean Difference	0	
df	115	
t Stat	2.85244275	
P(T<=t) one-tail	0.00257275	
t Critical one-tail	1.65821183	

Note - Significant at 5% level of significance

### 3.3. Losses in return for apple growers due to disaster and crop-raiding.

**Table 3.** Comparing the mean of the losses incurred in returns of the apple due to disaster and crop-raiding

t-Test: Two-Sample		
	<i>Variable 1</i>	<i>Variable 2</i>
Mean	34905.7534	14550
Variance	1849476516	2.54E+08
Observations	73	64
Hypothesized Mean Difference	0	
Df	94	
t Stat	3.7604383	
P(T<=t) one-tail	0.00014732	
t Critical one-tail	1.66122586	

Note – Significant at 5% level of significance

Table 3 reveals that the p-value is 0.00015 which is less than 0.05 which means that it is significant at 5% level of significance and the second null hypothesis is also rejected in the study. The result shows that the losses in return due to disaster and crop-raiding are not the same and there is a significant difference between them. The mean value of both the variables shows that loss in return of apple growers due to disaster is approximately rupees 34906 which is more than double the loss in return due to crop raiding i.e. rupees 14550.

### 3.4. Insurance of crops

Majority of the farmers of hilly areas depend upon monsoon for irrigation purpose and disturbance in monsoon put them into risk. Agricultural insurance is one of the possible measures to meet the risks that may occur because of the natural disasters and to ensure continuity of production in agricultural sector.

**Table 4.** Percentage of sampled farmers who have insured their crops (Apple)

Crop insured	Percentage of farmers
YES	17.5
NO	82.5

Source – Primary Data

Table 4 shows that only 17.5 percent of sampled apple farmers have insured their crops whereas a huge number of sampled farmers i.e. 82.5 percent have not insured their crop which means that the losses incurred due to any calamity are not compensated.

### 3. Conclusion

The result of the study shows that 91 percent and 80 percent of the farmers have experienced disaster and crop-raiding by animals respectively. The average of the losses in apple production due to disaster and crop-raiding is approximately 939 kg and 488 kg respectively. The average loss in the income of apple growers is almost rupees 34906 and rupees 14550. The study compares the apple production and return losses due to the reason of disaster and crop-raiding by animals and it has been seen that the disaster has more significant effect on the produce and return in comparison to crop-raiding. Apple production is one of the primary sources of income and employment for the farmers living in the study area. Farmers face income instability many times due to the effect of disaster and crop-raiding on apple production. The reduction in the income of farmers sometimes encourages them to migrate in search of alternative livelihood. Post disaster incentives, crop insurance policies can help them to sustain to some extent.

The government can bring out schemes of insurance for wildlife intervention and crop losses as well besides natural disaster crop losses which can cover their losses partially. It was found among the sampled farmers who had insured their crops that the amount of insurance is fixed irrespective of the losses incurred by the apple growers. Natural disaster is a natural phenomenon and so there is need for mitigation and post disaster support to the apple farmers so that their primary source of livelihood in the mountain is sustained while various mechanisms like wire fencing, compulsive orchards in up hills through subsidies to protect the crops down hills can help to save the livelihood of those apple growers in the mountains to some extent.

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