Journal of Economics, Management and Trade

Volume 29, Issue 11, Page 85-89, 2023; Article no.JEMT.109033
ISSN: 2456-9216
(Past name: British Journal of Economics, Management & Trade, Past ISSN: 2278-098X)

Assessment of Socio-economic Impact of Human-wildlife Conflict on Agriculture: A Case of Smallholder and Subsistence Farmers in Eastern Bhutan

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEMT/2023/v29i111164

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/109033

Original Research Article

Received: 08/09/2023
Accepted: 10/11/2023
Published: 15/11/2023

ABSTRACT

Human-wildlife conflicts are a great concern in where ecosystem services are shared between humans and wildlife animals. This paper examines the socio-economic impacts of human-wildlife conflicts. A descriptive survey design was employed in this study. Primary data were collected by using a simple random sample from 120 households. Data were analyzed using descriptive statistics including frequency and percentages. The study results showed that there is a substantial social and economic impact on the smallholder and marginal farmers through the loss of crops due to wild animals. The majority of farmers (23%) had incurred annual household economic loss ranging from US$49-US$59 per household.

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Keywords: Human-wildlife; farmers; implications; socioeconomic.

1. INTRODUCTION

Human-wildlife conflict (HWC) is a growing concern globally and poses a risk to the livelihoods of the rural farming community. Human-wildlife conflict threatens the socioeconomic outcomes of smallholder rural communities (Yang et al., 2020; Methorst et al. [1]; Sampson et al et al. [2]). Human-wildlife conflict occurs when the lives and properties of human communities are threatened (Milupi et al. [3]; Kolinski et al. [4]; Matseketsa et al. [5]). Human and wildlife conflict can be also attributed mainly due to the exploitation of natural resources and encroachment by humans on wildlife habitats (Pant et al. [6]; Sharma et al., 2020; Nicole [7]).

Bhutan is recognized as one of the top ten biodiversity hotspots in the world and has maintained organized efforts to conserve and establish an extensive network of protected areas in the country (Wangmo, 2019). However, there exists a tradeoff between the country's conservation policies and human-wildlife conflict in the country. The majority of the Bhutanese rural communities are residing adjacent to protected areas in the country. There has been a report of human-wildlife conflict cases every year in the country. The human and wildlife conflict varies spatially and with such factors as animal distribution patterns (Heinen & Youzen, 1994). The conflict between humans and wildlife in the form of livestock predation, house raiding, and even human attacks has been reported every year in the country (Wangmo, 2019).

Crop raiding is a common challenge for farmers globally (Mukherjee et al. [8]; Manoa et al. [9]). A study by the National Plant Protection Centre and World Wildlife Fund [10] in Bhutan, revealed that crop raiding is far greater in scope and magnitude than livestock loss, indicating the significant loss due to crop raiding in the country. A similar kind of study by JICA [11] also reported that about 30 percent of crops are lost due to crop raiding by wild animals in the country.

Empirical studies in Bhutan often fail to grasp the socio-economic implications of human-wildlife conflicts, and perceptions of this conflict often deviate from actual incidences of socio-economic impacts and their implications for the affected smallholder and marginal farmers. Despite an increase in the regularity of human-wildlife conflict cases in Bhutan (Yeshey et al., 2022; Letro et al. [12]; Katel et al. [13]), it is still difficult to reliably assess the socio-economic inferences of human-wildlife conflicts on affected household livelihood. Therefore, the present paper attempts to gain intuitions of the smallholder and marginal farming and the effects of crop and or livestock damage by wild animals.

1.1 Objectives of the Study

The main objective of this paper is:

- To assess the household economic value of crop and livestock loss as caused by wildlife damage.

2. METHODOLOGY

The main purpose of this study was to study the household economic value of crop or livestock loss caused due to wildlife damage. The study employed a quantitative research approach. The study was based on primary data sources. Primary data (*n*=120) have been gathered from participants with the help of a survey questionnaire. For the purpose of this study, Bartsham Gewog under the Trashigang district was selected. Trashigang district is located in the eastern region of Bhutan and is regarded as one of the biggest districts (3066 KM square) in the country. Electric fencing has been installed along 40 km of the boundary of five Chiwogs (sub-block) under Bartsham gewog in Trashigang. Trashigang district has one of the highest coverages in terms of electric fencing with 1170.32 acres in the country (NCD [14]). A primary data was collected by employing a household questionnaire survey. Following the simple random sampling framework, we collected samples (*n=120*) from the five chiwogs. Data were cleaned and analyzed using Statistical Package for Social Science (SPSS). Data were analyzed using descriptive statistics in the form of frequency and percentages.

3. RESULTS AND DISCUSSION

In terms of livelihood activities, 98.5% (n = 82%) of the study respondents households reported that crops and livestock are their main source of livelihood. Over 99% (n = 119) of study respondents reported incidences of crop and livestock damage by wild animals in the study

area. Crop damage in terms of crop field estimated in land area in acre is shown in Table 1.

The result findings further show that those respondents incurred economic and social costs as a consequence of conflicts between humans and wildlife in the study area. Crop damage led to direct economic costs while smallholder farmers incurred a variety of additional costs as households living alongside wild animals had to implement various mitigation investments in the study area. though these indirect costs were not easy to estimate quantitively, but were found to be substantial for the study.

Table 2 describes the estimated loss of crops due to wild animals measured in kilograms. Among the crop loss, maize and potato recorded the highest loss in terms of production loss due to wild animals in the study area. Crops namely maize and paddy and vegetable potato are the main major crops and vegetables grown and cultivated in the study area. however, it was found that the severity of crop loss in maize and potato was recorded highest in the study area.

Table 3 shows the estimated economic loss of crops due to wild animals in the study area. The majority of smallholding and marginal farmers incurred economic loss between the 49-59 range (23.3%), followed by the 69-79 range with an average of $71.97 in the study area. A high percentage of economic loss in these ranges indicates not a high severity of economic losses in the study area. This could be attributed to the electric fencing in the study area which hugely contributes towards the mitigation of wildlife in the study area. On the other hand, only 9.1 percent of farmers in the study area suffer from economic loss ranging between 59-69 with an average of $62.05.

Table 1. Estimates of the Crop Field Damage by Area (ac) of the Respondents' Households

Wild Animals	n	Sum	Mean	SD
Porcupine	112	60.3	0.79	0.47
Monkey	105	9.6	0.47	0.13
Wild Pig	116	36	0.30	0.31
Barking Deer	97	8.90	0.16	0.23
Birds	20	7.78	0.18	0.13
Samber	9	1.89	0.13	0.17

Table 2. Estimated Loss of Crops from Wild Animals (kg)

Crops	n	Sum	Mean
Paddy	5	649	134.03
Millet	2	461	49.18
Maize	47	16,734	320.48
Potato	9	473	210.37
Vegetable	7	659	163.26

Table 3. Estimated Economic Loss of Crops in Values ($) from Wild Animals

HH Affected	Crop Loss Range Value in USD ($) *	Percentage (%)	Average Crop Loss Value in USD Value ($) *
22	39 - 49	18.6	41.21
28	49 - 59	23.3	50.33
11	59 - 69	9.1	62.05
26	69 - 79	21.6	71.97
17	79 – 89	14.1	83.06
16	89 and above	13.3	93.59

** Losses were reported in Ngultrum (Nu.), and were converted to USD. 1USD ~ Nu. 80.00*

4. CONCLUSION

The study based on its findings concludes that smallholder and marginal farmers faced numerous results of human-wildlife conflicts and significantly impacted the socio-economic impacts of those marginal farmers in the study area. Porcupines, monkeys, and wild pigs were found to have huge economic losses in terms of crop field damage in the study area. On economic loss assessment, it was found that the severity of economic loss in terms of crop value is not that severe owing to various HWC mitigation implemented in the study area. However, the government should adopt and implement various other permanent reliable mitigation measures other than just providing electric fencing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/109033