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Human Wildlife Conflict and Impacts on Livelihood: A Study in Community Forestry System in Mid-Hills of Nepal

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Abstract: Human wildlife conflict (HWC) impacts the livelihood of many rural communities worldwide. This study investigated the impact of HWC on people living near community forests (CF) in Nepal. Using databases provided by the Division of Forest Offices and data obtained from surveys between October 2019–March 2020, we quantified the financial loss of HWC to the local people. Between 2015 and 2019, 3315, or 27%, of the livestock owned by the survey respondents were killed by wild predators in the Kaski and Tanahun Districts. Chicken (*Gallus* spp.) was the most common prey taken (80%), followed by sheep (*Ovis* spp.) and goats (*Capra* spp.) (15%), cows (*Bos* spp.) (2%), pigs (*Sus* spp.) (2%), and buffalo (*Bubalus* spp.) (1%). Leopards (*Panthera pardus*) were the primary predators, followed by golden jackals (*Canis aureus*), jungle cats (*Felis chaus*), yellow-throated martens (*Martes flavigula*), and Himalayan black bears (*Ursus thibetanus*). The financial loss of livestock during this period was USD $115,656.00, equivalent to USD $142.61 per household. Crops were also damaged and eaten by wildlife, and 2165 crop-raiding events were recorded between 2015 and 2019. Rice (*Oryza sativa*), followed by maize (*Zea mays*), millet (*Panicum miliaceum*), and potatoes (*Solanum tuberosum*) were the main crops lost. Rhesus monkeys (*Macaca mulatta*) were the most common crop raiders, causing 74% of the damage, followed by Indian field mice (*Mus booduga*) (12%). From 2015 to 2019, crop losses equated to USD $83,424.00. Forest regeneration on abandoned agricultural land expanded wildlife habitats, enabling wild animals to come within reach of human settlements, which increased the likelihood of HWC events. Although the success of the community forest restoration program resulted in increased forest-cover, marginally increasing biodiversity, the reduced distance between human settlements and wildlife habitat, compounded by a lack of natural prey, may have unwittingly exacerbated HWC in this region. We recommend surveying predator and prey populations in the forest habitat, and implementing a habitat management program to improve prey populations within the community forests. Meantime, we propose establishing a financial relief and insurance program for crop and livestock losses at the local community level to alleviate any financial difficulties to the local communities caused by HWC.

Keywords: community forestry; human wildlife conflict; livelihoods; Nepal; predators; crop-loss; habitat degradation and management

1. Introduction

Human wildlife conflict (HWC) occurs where wildlife and humans coexist and compete for limited resources [1–3]. HWC is more pronounced in areas with an ever-expanding human population, substantial habitat loss or modification, and, in some circumstances, where there has been an increase in forest-cover as a result of successful conservation actions [4,5]). Rural communities, whose livelihood totally depends on agricultural and livestock production, often suffer from economic losses when crops are raided, or livestock are killed by wild animals ([6–8]. Some wild animals, such as leopards (*Panthera pardus*), tigers (*P. tigris*), and Asian elephants (*Elephas maximus*), not only kill livestock, damage people's property, and spread disease, they also occasionally kill and injure people [9,10]. These events, especially those that cost human life, can lead to retaliatory killing of wild animals, including those that are legally protected, endangered, or threatened [11–14]). Consequently, HWC affects both the livelihood of people and wildlife [15], and at the same time, jeopardizes wildlife conservation goals [16,17]. Therefore, implementing conservation plans to mitigate against HWC is critical for safeguarding the lives and livelihood of people and wildlife conservation.

Wildlife conservation formally started in Nepal in 1958 by the promulgation of the Wildlife Conservation Act 1958 [10]. In addition, the WWF (World Wildlife Fund for Nature), in collaboration with the Government of Nepal, launched the first Rhino conservation program in Chitwan Valley in 1967, with the aim to increase the population of the greater one-horn rhinoceros (*Rhinoceros unicornis*), whose population dramatically declined in 1950s [18]. Since then, the government of Nepal has prioritized the protection of several large mammalian species, including endangered tigers and Asian elephants, and their habitat [19]. The initiative was strengthened by creating the National Park and Wildlife Conservation Act (1973). The Government of Nepal also launched a community-based forest restoration program in 1976 to protect natural resources and prevent the unsustainable utilization of natural resources [20].

Community forests (CFs) under the forestry program were government-owned forests handed back to resident communities so that the forest and resources could be locally and sustainably managed. Community forests comprise 39% of the total forest-cover in Nepal, and provide goods and services to 50% of Nepal's population [21]. The CF program was created as part of a Master Plan for Forestry Sector (1988) and Forest Act 1993, and is now the largest forestry program in Nepal. This successful forest management program improved forest habitats and benefited wildlife populations significantly [14,22–25]. Unfortunately, we have also observed more HWC events [11,26,27] due to an increase in wildlife population within the community forests, which has led to an increased number of HWC encounters between people and wild animals [28].

In recent years, many people have migrated from rural areas and mountainous regions to urban environments [29], and have abandoned or neglected their farms [30]. Furthermore, scrub and bush has quickly regenerated on these abandoned farms, allowing wild animals to venture closer to human settlements, resulting in a higher frequency of HWCs [11,31,32]. With fewer farmers working the land in these rural areas, wild animals have taken to attacking unprotected livestock and raiding unsecured crops [33].

Despite an increase in the number of HWC incidents, little data has been collected on the socioeconomic impact of HWC in these areas. Understanding the impact of HWC on the socioeconomic status of local people is essential for designing and implementing effective mitigation plans [34]. Studies on the causes of HWC, to date, have primarily focused on habitat fragmentation and degradation [11]. The combined effects of improved forest-cover in the CF areas alongside the regeneration of abandoned farmland on HWC has not been investigated. This study aims to examine: (1) types of HWCs in Kaski and Tanahun Districts, which are mid-hill regions outside of the protected areas of Nepal; (2) which animal species are involved in HWC events; (3) the socioeconomic impact of HWC on the local communities; (4) whether land-use change and restoration of community

forests has led to a change in the number of HWC events; and (5) recommended HWC mitigation strategies.

2. Materials and Methods

2.1. Study Area

This study took place in the Chitwan-Annapurna Landscape (Figure 1), which is a corridor for large wildlife between Chitwan National Park in the south and the Annapurna Conservation Area in the north. Within this region, we selected the Kaski and Tanahun Districts (27.744–28.625 N and 83.703–84.562 E, Figure 1), which ranges from a low-level (200 m ASL) tropical climate through to a cooler temperate in the high mountains (8091 m ASL: Mount Annapurna). In total, this area covers 3563 km^2. The mid-hill region (also known as middle mountain) is characterized by diverse ecosystems and wildlife [35], flowering and medicinal plants [28], and significant cultural and religious diversity [30,36].

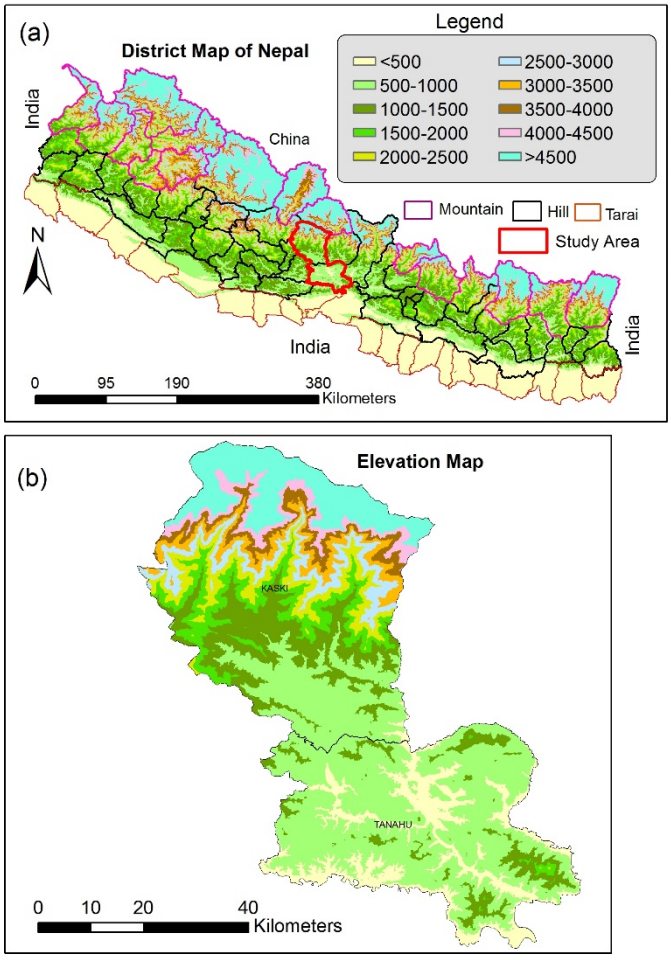

Figure 1. Location Map of study area (**a**) District map of Nepal with elevation (**b**) Elevation of Tanahu and Kaski districts.

The forest-cover is 1764.42 km^2 (47%) [37], and is dominated by *Shorea robusta, Terminalia tomestosa, Schima wallichii,* and *Castanopsis indica.* The mid-hill region is also rich in wildlife biodiversity, including some species that have been associated with HWC incidences in the past, such as leopards (*P. pardus*), golden jackals (*Canis aureus*), jungle cats (*Felis chaus*), wild boars (*Sus scrofa*), yellow-throated martens (*Martes flavigula*), barking deer (*Cervus vagianalis*), Indian civets (*Viverra zibetha*), Himalayan black bears (*Ursus thibetanus*), and Indian crested porcupines (*Hystrix indica*). There are 815,400 people living in this area, of which, 64% are working in agriculture, forestry, and farming [38]. Thus, human pressure on the land and forest is immense.

2.2. Data Collection

There are 1122 registered Community Forests in the Kaski and Tanahun Districts. By consulting with the Division Forest Offices, we selected 40 community forests (20 in Kaski and 20 in the Tanahun District) that ranked high in the reported number of HWC events during 2015 to 2019. Collectively, there were 4120 households listed within the community forest operational plans as of March 2020. We randomly chose 811 (19.68%) households (400 from Kaski and 411 from Tanahun) as respondents for our survey, and visited each household to survey the household members. As women collected more resources from the forests and undertook more farming activities, including animal husbandry, than men, we mainly surveyed the women in each household. Moreover, most males were engaged in other jobs and businesses, and so, could not provide the information we were seeking. All interviewees accepted our request and provided written consent for participating in the survey. All personal data were kept anonymous and confidential by using a coding system. The surveys were conducted in the Nepali language with the help of a forest ranger and/or local assistant. We surveyed people with different education backgrounds, gender, ethnicity, and religion. We asked them demographic and socioeconomic information, and whether they, or anyone else in their household, had encountered any HWC related events between 2015 to 2019 (Table 1).

Table 1. Major information taken from the respondents during questionnaire survey.

Demographic information	Gender, Age, Family size
Socio economic information	Household income level, Occupation, Literacy level
Major crops cultivated	
Major livestock reared	
HWC related information	
A. Crop loss	
	Year-wise types and amount of crops damaged by wildlife between 2015–2019
	Wild animal involved in these events
	Did you see which wild animal was involved in these events?
	If you didn't see, how did you identify which wildlife caused the loss?
	What is the current market price of this crop loss?
	Distance of crop loss site from nearest village (<1 km, 1–3 km, >3km)
	What mitigation measures have you been applying to decrease crop loss by wildlife?
B. Livestock depredation	
	Year-wise types and number of the livestock injured/killed by wildlife between 2015–2019
	Wild animal involved in these events
	Did you see which wild animal was involved in these events?
	If you didn't see, how did you identify which wildlife caused the loss?
	What is the current market price of this livestock loss?
	Land-use type of event site (settlement, forest, cultivated land/open areas)
	What mitigation measures you have been applying to decrease livestock loss by wildlife?
C. Human attack	
	Year-wise human injury/death caused by wildlife between 2015–2019
	Wild animal involved in these events
	Did you see which wild animal was involved in these events?
	If you didn't see, how did you identify which wildlife caused the human attack?

Table 1. *Cont.*

Land-use type of event site (settlement, forest, cultivated land/open areas)
What mitigation measures you have been applying to decrease wildlife attack to humans?

We verified the data we collected from the households with that from the Division Forest Offices (DFO) of the Kaski and Tanahun Districts. In addition, supporting data on crop damage by wildlife was also collected from published articles and reports, and verified using the database from the DFO's in Kaski and Tanahun between 2015 and 2019. We asked the respondents to describe the type of HWC event they, or a member of their household, encountered and to identify which animal was involved. We placed a variety of photographs of the animals and their sign (e.g., footprints, scats) in front of the respondents so they could verify which animal species was/were involved in the HWC event(s). We also interviewed 21 policymakers at the district level, including the forest director, divisional forest officers, field-level forest officers, municipality chairs, and other elected representatives, regarding the mitigation measures implemented to avoid HWC-related issues. Finally, we reviewed Nepal's wildlife and HWC policies, i.e., Forest Act (2019), National Park and Wildlife Conservation Act (1973), the Relief Fund Distribution Directive for Victims of Wildlife (2012), and the Crop and Livestock Insurance Directive (2013), to understand and evaluate the impact of these policies on HWC mitigation and wildlife conservation.

2.3. Land-Use and Land-Cover Change

Land-cover (LC) data for this study were extracted using Landsat 5 TM (Thematic Mapper), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and 8 OLI (Operational Land Imager) images for 1998/1999, 2008, and 2018. These images were collected from United States Geological Survey (USGS) site https://earthexplorer.usgs.gov (accessed on 9 October 2021) (Table 2) on multiple dates. All images were geometrically, radiometrically, and topographically corrected and verified for their accuracy. Accuracy assessments were conducted using high resolution Google Earth Images, (http://earth.google.com) (accessed on 9 October 2021) of multiple dates, topographical maps published by Nepal's Survey Department (Government of Nepal, 1998, scale 1:25,000, 1: 50,000), and field data (GPS points) which were reference points provided by the household members collected during the surveys. For the analysis of land-cover change, we applied eight land-cover categories, as recommended by Anderson et al. [39]. Based on the secondary data from DFOs, the 21 key personnel, and the survey respondents themselves, we found that Bhanu Municipality in the Tanahun District was the most affected area of HWC events. Given this, we then compared the effects of land-use change of this municipality with HWC events in 1999, 2008, and 2018.

Table 2. Landsat data used in the study. TM = Landsat 5 Thematic Mapper; ETM+ = Landsat 7 Enhanced Thematic Mapper Plus; and OLI = Landsat 8, Operational Land Image.

Path/Row	TM-1998	ETM+1999	TM-2008	OLI-2018
142/040		13 December	26 October	7 November
142/041	17 February	13 December	26 October	7 November

2.4. Data Analysis

We quantified the annual crop/livestock production (as a percentage loss) of respondents. As, generally, more women regularly enter the forests and worked more on the land, we tested whether they were more likely to be affected by HWC events than men by using a chi-squared test. A chi-squared test was also used to test whether HWC events were becoming more frequent through the years. All analyses were performed within R (R Core Team, 2018) [40].

3. Results

3.1. Demographic Information

Among the 811 respondents surveyed, 88% (n = 713) were women. The age of respondents ranged from 16 to 95 years old (median = 52 years), and the average family size was six individuals (range: 1 to 24 individuals). Eighty-six percent (700) of the respondents worked in the agricultural sector for their livelihood, followed by 9% (72) in business, and 5% (39) in other occupations. The literacy rate was relatively high for the area 78% (n = 729), and 70% (n = 564) of respondents were considered to have a medium economic status (based on Nepal's participatory wellbeing ranking).

3.2. Trends in HWC

Crop damage and livestock depredation data were collected from the surveys and databases provided by the Division Forest Offices (DFO) at Kaski and Tanahun. From the interviews, the respondents reported 2165 crop damage events and 3315 accounts of livestock being killed by wildlife from 2015 to 2019. This was vastly different from the DFO records, as only 938 HWC-related events were reported. The types of HWC events reported to the DFO were mainly livestock being killed or injured, wildlife being killed or injured, and people being killed or injured (Figure 2). Most, if not all, of the minor HWC events, e.g., crop losses, were not reported unless it was a significant loss. Not surprisingly, more women encountered HWC events than men (χ^2 = 4.2981, df = 1, p = 0.038).

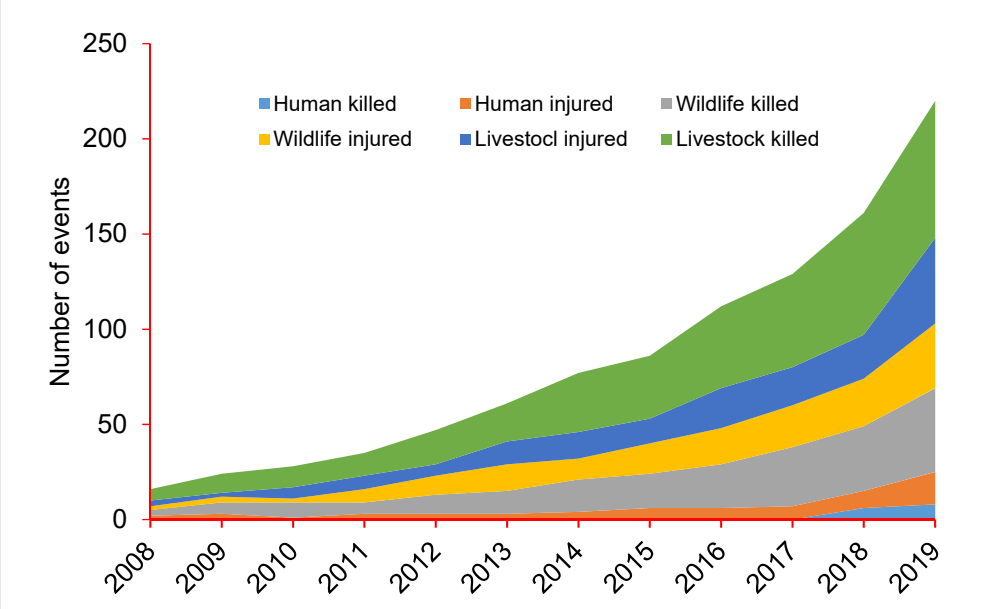

Figure 2. Number of wildlife attacks on livestock and humans, and number of wildlife killed by people (Data source: DFO, Kaski and Tanahun).

3.3. Livestock Predation

Data obtained from the interviews show that between 2015–2019, of the 3315 livestock killed (27% of all livestock owned), the main predators involved in these attacks were leopards, golden jackals, jungle cats, yellow-throated martens, black kites (*Milvus migrans*), and Himalayan black bears. Chickens (*Gallus* spp.) were the most commonly killed livestock species (80%) by these predators, followed by sheep (*Ovis* spp.), goats (*Capra* spp.) (15%), cows (*Bos* spp.) (2%), pigs (*Sus* spp.) (2%), and buffalo (*Bubalus bubalis*) (1%). Leopards killed the widest range of livestock, i.e., domestic goats and sheep (62%), chickens (18%), cows (10%), pigs (6%), and buffalos (*Bubalus*) (3%) (Figure 3).

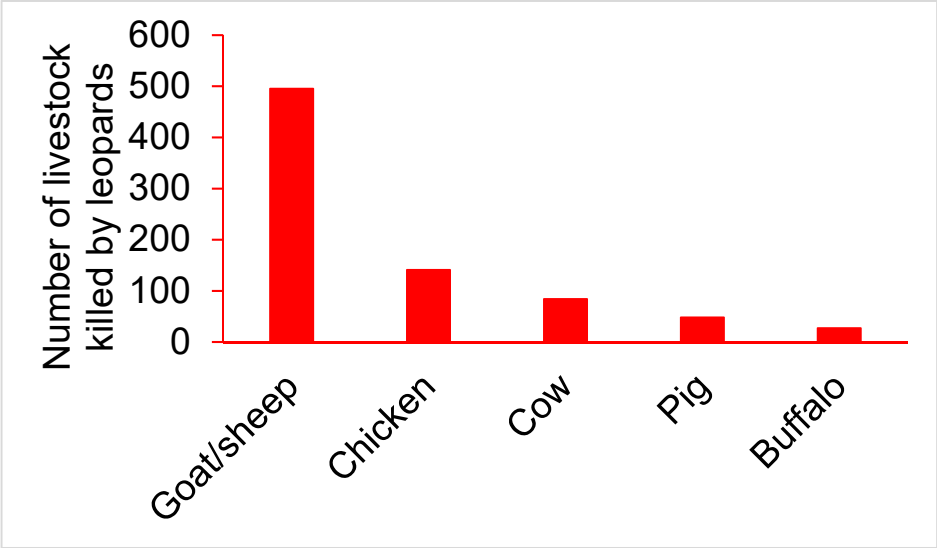

Figure 3. The variety and number of livestock killed by leopards in Kaski and Tanahun Districts between 2015–2019.

Himalayan black bears also killed pigs, whereas the remaining four wildlife predators (golden jackals, jungle cats, yellow-throated martens, and black kites) were only recorded to kill chickens. Livestock losses amounted to 13,300,440 Nepalese rupees (USD $115,656.00), or an average of USD $142.61 per household between 2015–2019. This represents an average loss of income of 23% per household.

3.4. Crop Damage

The main crops grown in these districts were rice (*Oryza sativa*: 63%), corn (*Zea mays*: 20%), millet (*Pennisetum scrobiculatum*: 9%), potato (*Solanum tuberosum*: 5%), wheat (*Triticum aestivum*: 2%), and mustard (*Brassica juncea* 1%).

The survey respondents recorded 2165 crop-loss events between 2015–2019. Proportionately, some crops, such as rice and corn, were severely impacted by wildlife (χ^2 = 39,506, df = 5, $p < 0.001$). Collectively, crop losses amounted to NPR 9,844,032 (US $83,424.00), or an average of US $102.86 per household. Crop loss accounted for 17% of the total household income of the respondents. Rhesus monkeys (*Macaca mulatta*) caused the most crop damage (74%), followed by Indian field mice (*Mus booduga*) (12%) (Figure 4).

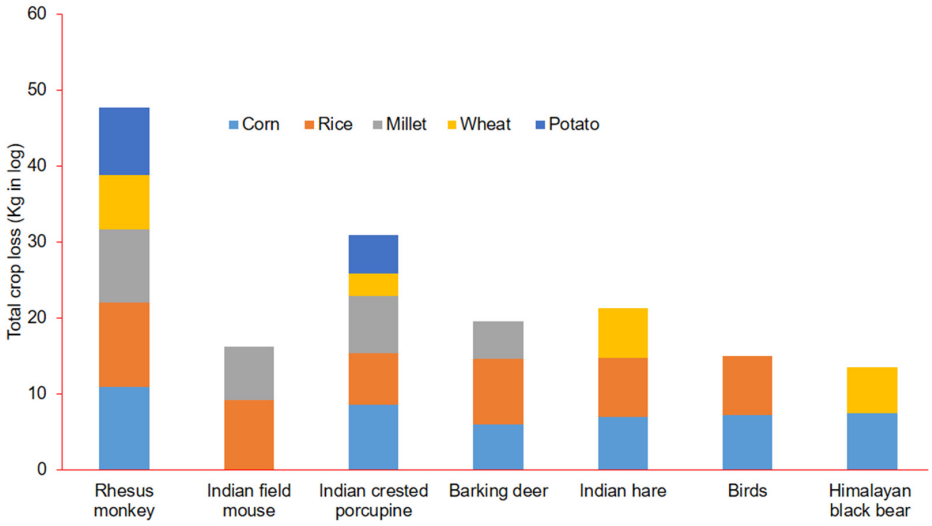

Figure 4. The amount of crop-loss in kilograms to different wildlife species within the Kaski and Tanahun Districts (data obtained from questionnaire surveys).

3.5. Land-Use Types and HWC

Most crop damage (78%) occurred within a 1 km radius of where people lived. Additionally, 64% of livestock attacks occurred near cattle sheds. Most livestock were attacked in the early evening or later at night. Some livestock (27%) were also attacked by predators when they were grazing within the community forests. The remaining predation events (9%) occurred on cultivated land or in open areas.

3.6. Land-Use Change, Community Forest, and HWC

Satellite imagery from 1998, 2008, and 2018 showed that the land-cover changed during this period, with cultivated land decreasing by 3.5%, and forested land increasing by 3%. In 1998, 43% of the land was forested (1593 km^2), whereas 32% (1170 km^2) was cultivated for agriculture (Figure 5; Supplementary file S1). In some areas, such as the municipality of Bhanu in the Tanahun District, cultivated land decreased from 1998 to 2018 by 20.52% (from 94.0833 to 74.7785 km^2) (Figure 6, Supplementary file S2). Of the 19.30 km^2 cultivated land lost, 15.75 km^2 was converted to forest, and the remaining 3.55 km^2 was either impacted by urbanization or reverted to barren areas or shrubland. Overall, the forest-cover increased by 18.23% (86.39 km^2 in 1998 to 102.14 km^2 in 2018) (Figure 6; Supplementary file S2). Only a fraction of the forest land (0.96 km^2) was transformed into cultivated land (Figure 6; Supplementary file S2) during the same period.

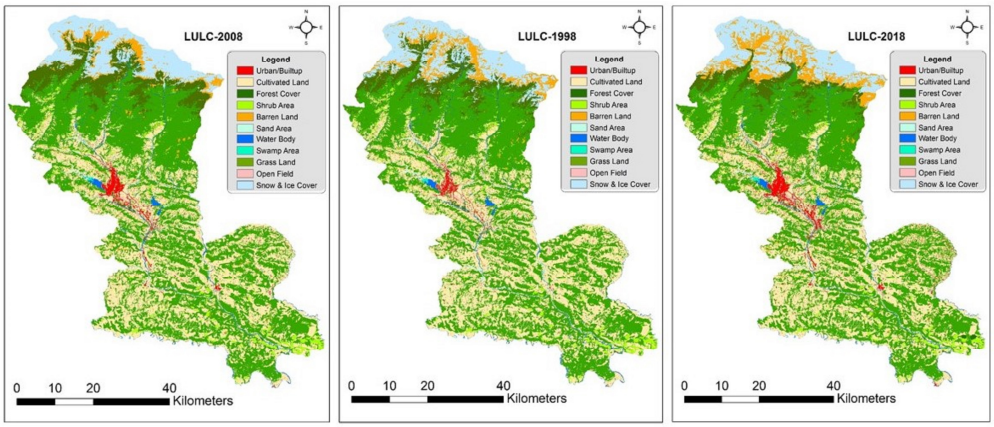

Figure 5. Land-cover map of study area in 1998, 2008, and 2018 in Kaski and Tanahun districts.

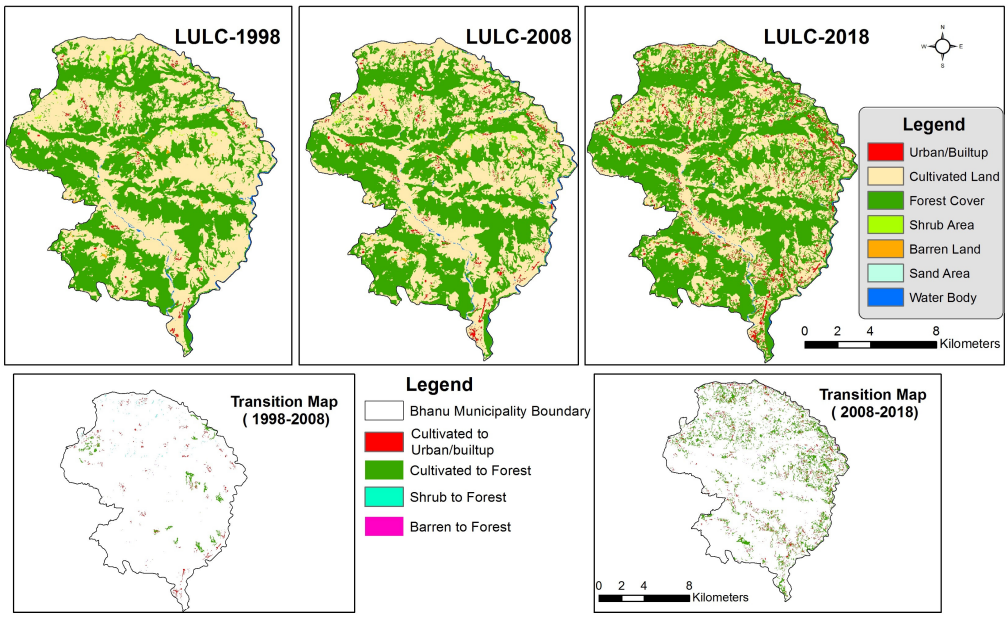

Figure 6. Land-cover transition map of Bhanu Municipality in 1998, 2008, and 2018.

4. Discussion

Our survey recorded 2165 crop-loss events and 3315 domestic animals killed from 2015 to 2019. Yet, the DFO database in the same area only had records of 938 HWC events between 2008 and 2019. The reasons for these discrepancies are: (1) records in the DFO database of HWC events only formally started in 2012, after the compensation/relief scheme to victims of HWC events was instigated by government of Nepal; and (2) many HWC events, such as crop-losses, were not reported because of the lengthy bureaucratic process to obtain the funds and the small amount of compensation on offer for any such losses. Some respondents possibly expressed exaggerated statements of their loss by wildlife pertaining to the number of livestock killed and amount of crop damaged in the hope that they may receive higher compensation packages from the authorities [7]. However, we verified their statements by crosschecking the survey data with the DFO records, and verified the information provided independently by interviewing other family members.

The villagers of the Kaski and Tanahun Districts lost 27% of their livestock to wildlife predation from 2015 to 2019, representing 23% of their household income. Chickens, goats/sheep, and cows were the main species lost. Generally, the domestic animals were kept in herds, making them easy prey. Similar predation events were observed in India near the Kibber Wildlife Sanctuary, where local farmers lost 18% of their livestock to wildlife, representing 25% of their household income [41]. Leopards, golden jackals, yellow-throated martens, and black kites were the main predators that attacked and killed livestock, whereas rhesus monkeys were the main crop raiders. Leopards and rhesus monkeys are well-known pest species by the local communities within the middle mountains [8,32,42]. Leopards generally attack and kill the larger livestock species, e.g., cows and goats [32], whereas golden jackals and jungle cats target chickens. Due to their inquisitiveness, intelligence, and close proximity to people, rhesus monkeys also caused the highest amount of crop damage in the surrounding Shivapuri National Park [42], Langtang National Park [43] and Chitwan National Park [44] of Nepal. Primates are the dominant pest for crop damage in Africa as well [45].

Livestock depredation by wildlife often coincides with ineffective farming practices, such as little or no fencing, poorly constructed livestock shelters, and allowing livestock to roam in open pastureland or wander into the community forests where the predators naturally reside [32]. Thus, better husbandry practices, including constructing safe enclosures, better fencing, and stall feeding, would help deter and prevent many livestock predation events by wildlife [45,46]. Most people within the Kaski and Tanahun Districts are poor, and only farm a few goats, sheep, and chickens: on average, most households had six animals [47]. Thus, losing any livestock to predators incurs significant hardship, and has major ramifications for their livelihoods (K.B. personal observation).

From 2015 to 2019, 67% of HWC incidences occurred outside the protected areas (PAs) where the large predators live [10]. While the Division Forest Offices have been conducting training and capacity-building programs for the local communities about forest management, they teach virtually nothing on wildlife or conservation management techniques. Hence, there is a lack of knowledge among the local people about living with and working around large predators [24]. The Community Forest user groups used the Community Forestry Development Directives 2001 endorsed by the Department of Forest and the Government of Nepal to formulate their Community Forest Operational Plan. However, the template does not provide any provisions for dealing with wildlife management within the CFs. So, none of the community forests had incorporated wildlife conservation practices into their operational plans. This is a significant gap for managing large predators outside the protected areas. Thus, provisions in these user-group directives are urgently needed to address this issue in order to reduce and mitigate further HWCs.

Out of Nepal's 77 districts, crop raiding is a significant problem in 69 districts [10,42,43]. In Kaski and Tanahun, the farmers lost 17% of their total income due to crop damage alone. Inadequate fencing and security means crop raiders can access crops with relative ease. Though fencing or electric wires and other security options act as good deterrents, they

are too expensive to install and maintain for the majority of the local farmers. This is also true in many other developing nations [48]. For example, in Tanzania and India, many farmers lost income from crop raiding by wildlife because they could not afford to construct secure fencing systems. [48,49]. Increasingly, agricultural losses from wildlife are severely impacting the economic and social well-being of farmers, which further exacerbates the financial hardships faced by local people [50].

Some of the reasons rhesus monkeys likely targeted the crops are: (I) a lack of fruit trees/food in the forest; (II) the ease of access to crops; (III) an increase in the monkey population [43]; and (IV) the forest regeneration on abandoned agricultural land, allowing the monkeys to move closer to farming areas. Previously, the natural forests contained abundant fruit trees, such as mango (*Mangifera indica*), guava (*Psidium guajava*), banana (*Musa sapientum*), gooseberry (*Ribes uva-crispa*), fig (*Ficus carica*), etc. [49], which would have provided sufficient food for the monkeys. However, many of the fruit trees have since been felled to make room for timber production [20,24]. The scarcity of wild fruits means the monkeys and some other herbivorous animals have now taken to invading the nearby farms to find alternative foods. Hence, cultivating the fruit trees in the forest and its edge would create a good habitat for monkeys and herbivores, and, consequently, they would be less likely to invade the cultivated land for food [45].

The Community Forestry program is generally regarded as a successful program, as the rural communities are now able to control, protect, and manage their own forest resources [11,22]. The program was implemented under the National Forestry Plan in 1975 to counter massive forest loss. The initial objectives of this program were to rehabilitate the degraded forest land and provide afforestation opportunities [51,52]. Through the active participation of the local communities, the forests have regenerated, and the forest-cover has increased. In the 1990s, the target of the community forest program was fulfilling the needs of the local people for timber, fuelwood, grass, fodder, and medicinal herbs. Moreover, it empowered many women and disadvantaged groups to generate income, and manage and develop their capacity in forest resources management [52]. After 2000, the program focused on the livelihoods of the local people, good governance, and sustainable forest management [52]. However, the priority of the forestry policy was focused on growing production trees for timber harvesting, rather than on biodiversity conservation or enhancing species diversity and ecosystem function [52]. Hence, little consideration was given to the needs of the wild animals living within the forest. During this same period, there has also been a reduction in the amount of grassland available for wild herbivores to graze within forest land. This, along with a lack of prey availability in the natural forests, may have forced predators to seek alternative prey in nearby villages, resulting in increased HWC in this area.

Satellite maps show the expanding forest areas and a decrease in cultivated land. The National Forest Resources Inventory of Nepal 2015 shows an increase in tree-cover from 39.6% to 44.76% between 2005 and 2015 [37]. Of this forest area, 90% is conventional forest, and 4.38% is re-vegetated secondary forest on retired or abandoned agricultural land. The increase of trees on the abandoned agriculture land has happened since people migrated to urban areas for education and employment opportunities [29,53–55]. One downside of this emigration is that fewer people are now working the arable land and watching over their livestock [56,57]. Furthermore, forest regeneration on abandoned land has created additional pathways and corridors [30], enabling wild animals to move even closer to human settlements, and increasing the likelihood of wildlife encounters with people, their crops/livestock, and property. Thus, the deforestation and degradation of natural habitats, combined with an increase in forest area [11,58] and with regenerating scrub on abandoned farmland, all contributed towards increasing the probability of a HWC event [37].

The Ministry of Forest and Environment (Government of Nepal) has a Relief Distribution Directive for damages caused by wildlife which was endorsed in 2012 [59]. This scheme pays up to (NPRs) 10,000 Nepali Rupees (~USD $85.5) for crop damage, NPRs 30,000 (~USD $256.5) for livestock loss, NPRs 20,000 (~USD $171) for minor injuries to

people, and up to NPRs 200,000 (~USD $1710) for serious injuries. In the event of a person being killed, the scheme provides a maximum of NPRs 1,000,000 (~USD $8547) to the family. DFO records in the Kaski and Tanahun Districts show that NPRs 22,653,600 (equivalent to USD $193,620) were paid out for crop, livestock losses, and human injury/death between 2015–2019 [60]. Though this scheme helped mitigate the impact of HWC, most respondents felt that the process of applying and obtaining these funds was overly bureaucratic, time-consuming, and complex. Unfortunately, there is no local relief fund, and all applications have to submit their claims to the federal government. Thus, only those people who incurred major losses submitted claims for HWC issues. Those who incurred smaller losses did not bother to submit claims. These losses, though small, still had a significant financial impact on the individual farmers.

The Ministry of Agriculture and Livestock (through the Government of Nepal) has implemented an insurance plan for the loss of agricultural crops and livestock loss. This insurance plan was established in 2013. Yet, of the 811 respondents interviewed, only 9% (n = 73) knew about this policy, and none of them had ever applied for insurance compensation. Thus, nobody had ever received any money from this policy for their crop and livestock losses because of wild animals. It is important that the local people are not only informed about these compensation plans and insurance policies, but that they receive assistance to submit and process the claims. Thus, it is important to make these systems accessible and easy to apply in order to alleviate the suffering and financial hardship of local people due to HWC. This would also greatly reduce the resentment and retaliatory actions of the local community towards the native wildlife, should an HWC event occur.

5. Conclusions

The local people in the Kaski and Tanahun Districts within the mid-hill area of Nepal are highly prone and susceptible to HWC. Land-use changes have enabled wild animals to move nearer to human settlements for food and resources, which increases the probability of wildlife raiding their crops, attacking livestock, and injuring or killing people. A holistic management plan that is balanced with clear administrative processes is required urgently in this region to address the issues of HWC. Such a plan requires the involvement of all the stakeholders, such as the local farmers/community, government officials, and wildlife scientists. Issues such as stock management (protecting and securing crops and livestock) can be done through grants for securing their crops and premises, training, and education. A general awareness program on human safety and well-being, and wildlife conservation would be immensely beneficial, particularly for those people living near the community forest areas. Managing wildlife within the community forests is also essential so they have the necessary food, water, and shelter within forests. In addition, a management program should provide economic incentives for people to stay in the region and carry out agroforestry on their land, rather than migrate to urban areas. Finally, establishing a local relief fund and insurance program for crop and livestock loss to HWC, rather than using a national overly-bureaucratic mechanism, would give confidence to the local community should they ever incur future damages, and this would greatly improve the co-existence of people and wildlife.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132313170/s1, S1: Land cover change in Kaski and Tanahun District since 1998 (Sq km), S2: Conversion of land sue type from one category to another from 1998 to 2018 in Bhanu municipality of Tanahun district (Sq km).

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