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**Assessing Resilience to Flooding and Human Wildlife Conflict in Developing
Countries: A Case Study of Flood Related Trauma and Human Wildlife Conflict in
Nepal**

Abstract

Developing countries have a large population that is dependent on farming and agriculture, making them more heavily reliant on natural resources like forest and water. Nepal is one of such countries, with a unique geography where much of the population lives in close proximity to conservation areas and water bodies. Due to these natural features and increased environmental pressures such as extreme storms and deforestation, many of these communities have experienced loss, ranging from property damage to human injury or death because of the related extreme flooding and increased human-wildlife conflict. These challenges are amplified in Nepal due to the nation's dependency on agriculture for their livelihood; the resources required to ensure resilience to such events are scarce. The second chapter of this research focuses on human-wildlife conflict (HWC) issues. While a government-issued HWC compensation policy exists, it has proven ineffective for victims that have low accessibility to even report their loss; this study aims to explore possible factors influencing the propensity to report loss. All 197 survey participants reported suffering from crop raid by wild animals, and about 60% reported livestock death. Results revealed that socio-demographic factors such as age, gender and

family size, in addition to the wild animal species responsible for loss, were statistically significant in influencing the likelihood of reporting loss. The third chapter of this research focuses on the individuals' likelihood of recovery from emotional trauma after extreme flooding events evaluating both tangible and intangible loss, as well as the role of demographic and socioeconomic factors that affect the likelihood of an individual's emotional recovery. An in-person household survey conducted in 2017 found that approximately 89% of respondents had not recovered from trauma that they experienced due to a severe flood in 2014, which was the most recent high damaging flood at the time of the survey. Factors such as the size of land held and the loss of livestock, agricultural land, assets, and/or houses were statistically significant in predicting the likelihood of recovery. The research findings from these studies investigate the role of policy design to improve governmental assistance within disaster-affected communities in developing nations. In these particularly sensitive regions of the world, it is essential that policy design meet ecological needs while addressing social equity to ensure economic and environmental resilience.

Keywords: Developing countries, Natural Disasters, Resilience, Protected areas, Flood, Emotional trauma, West Rapti River, Nepal, Banke National Park, Human-wildlife conflict, Logistic regression

MONTCLAIR STATE UNIVERSITY

ASSESSING RESILIENCE TO FLOODING AND HUMAN WILDLIFE CONFLICT
IN DEVELOPING COUNTRIES: A CASE STUDY OF FLOOD RELATED TRAUMA
AND HUMAN WILDLIFE CONFLICT IN NEPAL

by

GITA BHUSHAL ADHIKARY

A Master's Thesis Submitted to the Faculty of
Montclair State University

In Partial Fulfillment of the Requirements

For the Degree of

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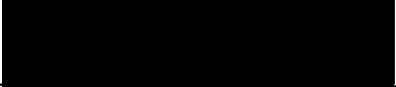
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Montclair State University

Montclair, NJ

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To my family

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List of Abbreviations

BaNP:	Banke National Park
CBS:	Central Bureau of Statistics
CFUG:	Community Forest User Group
DNPWC:	Department of National Parks and Wildlife Conservation
DFRS	Department of Forest Research and Survey
HWC:	Human wildlife conflict
IFRC:	International Federation of Red Cross and Red Crescent Societies
IUCN:	International Union for Conservation of Nature
PCLG:	Poverty and Conservation Learning Group
PTSD:	Post Traumatic Stress Disorder
TAL:	Terai Arc Landscape
USAID:	The United States Agency for International Development
VDC:	Village Development Committee
WRR:	West Rapti River

1. Introduction

Since the beginning of civilization, people have depended on the natural resources; the course of history has shown peoples' preference towards living near river banks and forested areas due to the fertile soil, which is important for agricultural growth, and access to fresh water, animals, and plants with medicinal properties. In developing areas, communities often rely heavily on agriculture for their livelihood; this dependence encourages multi-generational farms operated by relatively large families. The workforce's incentive to have a large family, however, further strains natural resources which can cause unintended environmental consequences. With a growing populations' strain on natural resource availability, the thereafter forest fragmentation has shown an increased potential for natural disasters and unintended human-wildlife contact. Furthermore, forest fragmentation has shown a positive association with wildlife attacks, although the impacts may vary based on the specific niche requirements of a wild species (Acharya et al., 2017). For example, conflicts between humans and *Loxodonta africana africana* (savannah elephants) in Botswana are mostly localized within agricultural areas where people encroach on elephants' natural habitats. Elephants have a large foraging range and, in Botswana, move to large water bodies in the same period that farmers harvest their fields; left unattended, an elephant can destroy a farmer's crop and livelihood in one night (Sobrevilla, 2016). While the development of civilization requires the use of natural

resources, there are many unintended consequences that can cause physical, economic, and emotional harm to communities.

Thus, the competition between people and wildlife for the same resources has heightened human-wildlife conflicts (HWC) at an alarming rate. By definition, HWC involve “situations occurring when an action by either humans or wildlife has an adverse effect on the other” (Conover, 2002), but this definition has been criticized for generating a myth that wildlife is a “human antagonist” (Peterson et al., 2010). While Young et al. (2013) distinguished between human-wildlife impacts and human-human conflicts (i.e., pro-wildlife versus those defending other positions), Liu et al. (2010) identified protected area-community conflict as a distinct subgroup. To address the HWC, in the 19th century, countries around the globe established national parks with an aim to balance the wildlife population and halt human-wildlife conflict (Allendorf, 2007). Globally, national parks occupy roughly 15.5 million square kilometers of land and protect threatened and endangered wildlife species in their natural ecosystems (Allendorf, 2007; Gray et al., 2016; Melillo et al., 2016). Between 300 million and 350 million people are estimated to live within or near dense forests worldwide (World Bank, 2018a; World Wildlife Fund, 2018), and one fifth (1.3 billion people) of the global population directly depends on the forest or forest products for either livelihood or income (World Bank, 2018b). Many people residing near protected areas live in poverty and bear the burden of nature-related impacts (de

Sherbinin, 2008). Generally speaking, households in closer proximity to protected areas are more prone to experiencing crop loss and livestock depredation as forms of HWC (Karanth et al., 2012; Linkie et al., 2007). Of those impacts, ongoing land-use changes and lack of supplemental natural resources for local residents has slowly made human-wildlife interactions more common, and thus, conflicts have begun to arise (Karanth et al., 2017; Stræde and Treue, 2006). Therefore, to mitigate these conflicts, the establishment of specific conservation areas brought rules and regulations to follow for preservation of endangered species.

Some conservation laws keep people from killing the wildlife. This may help to increase wildlife population but could also lead to a rise of HWC with people living in nearby areas. In certain affected areas, there are systems led by conservation or governmental offices that allow for compensation for those that report loss caused by the conserved wildlife, which is useful for preserving wildlife while also helping people cope with the problem. Compensation programs come in a variety of iterations but can be mostly characterized as *ex-ante* or *ex-post* payments against loss of assets or life to wildlife. Insurance against losses (*ex-ante*), either solely or combined with *ex-post* payments, are favored by countries like Pakistan, Sri-lanka, Mongolia, and Namibia (Morrison et. al., 2009) while compensation after losses (*ex-post*) is favored by countries like Nepal, Italy, South Africa, North American countries, and Bhutan (Boitani and Raganella, 2010; Sangay

and Vernes, 2008). Unfortunately, not all compensation programs are effective in solving regional problems related to HWC. Many compensation programs, especially in developing countries, suffer from low compensation rates, corruption and bureaucratic apathy (Mishra 1997; Madhusan 2003).

As some of these compensation programs have shown unfavorable or ineffective, some people choose not to, or are unable to, report their loss to receive compensation. This unfortunate circumstance can lead to people sustain loss without any compensation, which can dampen perception towards wildlife further challenging the relationship between humans and protected wildlife. In certain areas where local economies rely heavily on wildlife-based tourism, the human-wildlife relationship is crucial for economic prosperity. This relationship proves challenging, as the sharing of resources greatly impacts those residing near protected lands.

Given farmers' small assets, loss of even a small share of crops can cause food shortage throughout the year. Therefore, we need to understand why some people fail to report the conflict they face. Also, we need to explore the factors that might influence the reporting habit before making any conservation/compensation strategies in and around national parks near human settlement area. This will not only help to improve the preservation of wildlife but also ensure people's well-being, maintain the tourism industry, and achieve the conservation goals.

In addition to forested lands, water resources are also essential for the development of civilization, as aforementioned, and communities are frequently developed in areas close to water bodies. While proximity to water bodies is essential for many communities' wellbeing, this closeness can also lead to challenges concerning weather-related damages. Due to climate change and the changing geographical structure of the globe, flood-related disasters account for 40% of natural disasters and are considered the most damaging in terms of social, economic, and humanitarian losses globally (United Nations Office for Disaster Risk Reduction, 2018; World Economic Forum, 2018; Ohl and Tapsell, 2000). More than one-third of the world's land area is estimated to be flood-prone, affecting approximately 82% of the world's population (Dilley et al., 2005).

Furthermore, anticipated effects of climate change are likely to induce a higher probability of floods resulting from intense precipitation events (i.e., 100 mm/day) (Baidya et al., 2007). The Annual Disaster Statistical Review 2017 reported that in 2017, there were 335 reported natural disasters observed globally, affecting 96 million people, resulting in 9,697 deaths, and totaling an estimated cost of 334 billion USD throughout the global economy; Asia was the most vulnerable in terms of floods and storms, accounting for 44% of disaster events, 58% of total deaths, 70% of affected population, and 9.4% of economic loss (Below and Wallemacq, 2018). Such natural disasters or climactic hazards can have an apparent impact on the environment and community infrastructure, which can result in

psychological and mental health issues associated with loss, disruption, and displacement (Walker-Springett et al., 2017; Few 2007).

The effects of such natural disasters are more evident in developing countries due to a lack of resources available to assist with rescue processes, lower available income, dependency on international funds for resilience, and a lack of insurance policies that cover the medical expenses or compensation for re-building shelters. Increasing population in unplanned settlements associated with developing countries make them even more vulnerable to disasters like earthquake, flood, and landslide. Forest fragmentation due to settlement, and structural development projects such as roads, irrigation canals, and river embankment further affects geographical features, which further intensifies the chances of flash floods yearly.

Developing countries like Nepal, India, and Bangladesh had experienced increased overflow in their river banks during monsoon season due to such infrastructural changes (Dixit et al., 2007). Bangladesh and Nepal are listed as two densely populated least developed countries in South Asia to experience flood each year with huge impacts on their economy (Dewan, 2015). Floods can lead to negative health impacts such as morbidity, mortality, injuries, drowning, hypothermia, and animal bites; and in developing countries where resources to treat such conditions are minimal, these misfortunes are even more profound (Du et al., 2010). In addition, damages to homes, institutional buildings (i.e.

schools, hospitals), agricultural land, and transportation support (i.e. roads, bridges) can further affect long-term concerns such as the spread of communicable diseases, rates of starvation, poor mental health, and poverty. This thesis will focus specifically on Nepal, a developing country in Asia, recognized as a biodiversity hotspot with many protected wildlife in addition to its diverse geographical features, making it prone to natural disasters.

Nepal, a developing country in South Asia, has forested areas that make up 44.74% of the country, and protected areas make up 23.39% (Bhattacharjee et al., 2017; Department of National Parks and Wildlife Conservation [DNPWC], 2017; Department of Forest Research and Survey [DFRS], 2015). In addition, the country is considered one of the richest countries in water resources, and has more than 6000 rivers and rivulets along with the Himalaya mountains, like Mount Everest, which further intensifies the water-induced disasters. Due to these natural features, forested areas have intensified human-wildlife conflicts, and the country has suffered from floods and landslides, among other natural disasters. Both of these incidents have been studied; however, the possible factors that influence the likelihood of reporting loss by those who experienced human-wildlife conflict, and the emotional recovery after experiencing extreme flooding events is not yet evident.

Thus, this research explores the aforementioned problems, using the example of Banke District which has experienced environment-related challenges with both human-wildlife conflict and extreme flooding. Chapter 2 will address the likelihood of reporting loss after human-wildlife conflicts, followed by Chapter 3 which will address the emotional trauma following flood events.

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2. Incidence of human-wildlife conflict and likelihood of reporting losses: The case of Banke National Park, Nepal

2.1 Introduction

Nepal, a developing country, is a rich biological hotspot with 118 different ecosystems that support 3.9% of the world's mammals, 8.9% of the world's birds and 3.7% of the world's butterflies (Paudel et al., 2011). The altitudinal variation range of 60 to 8850 meters above sea level and heterogeneous geomorphology within the country has influenced the species richness and beta diversity, supporting approximately 12,000 plant and fungus species, 208 mammal species, more than 219 alien species of flowering plants and 64 endemic animal species (Bhattacharjee et al., 2017; Budha, 2015). Due to lack of scientific research, many invasive and endemic flora and fauna are yet to be discovered (Shrestha, 2016). Forested areas make up 44.74% of Nepal, and protected areas make up 23.39% (Bhattacharjee et al., 2017; DNPWC, 2017; DFRS, 2015). The National Park and Wildlife Conservation Act of Nepal has prioritized 27 mammal species, 9 bird species, and 3 reptile species; among these species, 33.3% are endangered and 15.4% are vulnerable under International Union for Conservation of Nature (IUCN) Red List (DNPWC, 2018). The country has been supporting 84.53% of its total mammals via protected areas only (Shrestha et al., 2010). There are six conservation areas, twelve national parks, one wildlife

reserve, and one hunting reserve in the country totaling in 23.39% of the total land (DNPWC, 2018).

As the protected area land has increased from 7.7% of the total land area of the country in 1990 to 23.39% in 2017, rural communities living near forested areas, protected or not, have been affected as they rely on regular access to be able to collect firewood, wild fruits, forest timber and other non-timber forest products (DNPWC, 2017; The World Bank, 2018b). Sixty eight percentage of the national population depends on agriculture for their livelihood and is directly/indirectly dependent on forest or forest products for their livelihood (USAID, 2018).

The establishment of protected areas has had some negative consequences such as food insecurity and minimum options for income generation for the people whose income and wealth are limited (Upadhyay, 2013). Despite relatively small land area, 17% out of total area, the southern belt of Nepal also known as Terai, supports nearly half of the country's population with its three main industrial areas clustered in Biratnagar, Birgunj, and Nepalgunj (Paudel et al., 2011). The migration within the country starting 1960's has resulted in population growth in the Terai region due to its agricultural productivity. The majority of the Terai population who reside near forest areas are illiterate, poor, and dependent on agriculture and forest products for their livelihood (Neupane, 2018). Thus, the increasing trend of population growth in the region has resulted in forest fragmentation

or destruction, which has intensified the frequency of human-wildlife conflict to the detriment of both sides (Neupane, 2018).

In Terai, protected large mammals like *Rhinoceros unicornis* (Indian rhinoceros), *Panthera tigris tigris* (Bengal tiger), *Panthera pardus* (Common leopard), and *Elephas maximus* (Asian elephant) directly contribute to existing HWC. The size of these animals makes HWC particularly dangerous; for example, human-elephant conflicts account for 40% of HWC reports, but accounts for 70% of HWC human casualties (Bajimaya, 2012; Neupane et al., 2017). Direct damages to livestock, crops, and human life caused by wildlife have resulted in significant costs to local people, limiting the ability to cope with those losses; this has resulted in food insecurity, increased workload, and economic hardship (Dickman, 2010; Kaitopok, 2015; Karanth et al., 2012).

To address these issues, the Nepalese government launched a compensation scheme in 1998/1999 for Chitwan National Park; following this policy, a more modern compensation policy/guideline was introduced in 2009 to include all the protected areas in the country (Poverty and Conservation Learning Group [PCLG], 2012). This policy applies nationwide to provide financial support to victims or their dependents for various types of losses caused by wildlife (Acharya et al., 2016). The guidelines have provisions for compensation of loss of human life and livestock, damages to vegetables, fruit orchards, and physical assets, and treatment in case of injuries to help people cope with wildlife while

simultaneously protecting it (Government of Nepal, 2009). The compensation scheme has prioritized human injury or death followed by livestock depredation over crop loss, loss of stored grains, and damaged houses (PCLG, 2012). The report prepared by Research and Development Center-Nepal (2018) remarked that the human-wildlife conflict was poorly addressed by the park authorities of Banke National Park (BaNP); between 2015 and 2017, people reported 86 domestic animals were killed by common leopards and US \$2,124 was distributed in total as a compensation among the victims who reported the loss (US \$1= 103.41 Nepalese rupees, currency exchange rate as of July, 2017).

2.2 Methods

2.2.1 Study Area

This study was conducted in one of the newest protected area of Nepal: Banke National Park. Established on the 12th of July 2010, it serves primarily to protect Bengal tigers and be a part of the corridor for Terai Arc Landscape (TAL), an area of global biodiversity significance (BaNP, 2017; Sunquist, 2010). TAL supports the highest recorded population density of Bengal tigers in the wild and has been recognized as a high priority conservation landscape (Dhakal et al., 2014; Johnsingh et al., 2004; Sunquist, 2010; Wikramanayake et al., 2004). BaNP supports 124 plant species, 300 species of birds, 22 species of reptiles, 50 species of fishes, and 22 species of reptiles within its 8 different

ecosystems (Ayadi, 2011). Further, a 2014 census using camera traps suggested that the park provides protection to an additional 31 wild mammal species (Chanchani et al., 2014).

BaNP extends over 550 square kilometers in Banke district while its 343 square kilometer buffer zone encompasses parts of Banke, Dang, and Salyan districts. The core area of the park lies in Chisapani-Obari section of the east-west highway (Ayadi, 2011); our study area focused on the settlements of Chisapani area, which is now known as Baijanath Rural Municipality-1 (Local Governance and Community Development Programme-II, 2018). The buffer zones of BaNP have 4,861 households with a population of 35,721, with 90% being agriculture dependent (Research and Development Center-Nepal, 2018). Baijanath rural municipality ward (hamlet) number 1 in the buffer zone of BaNP was selected as the study area based on its proximity to the National Park (Figure 1). The residents of the study area rely on subsistence farming of rice, wheat, maize, mustard, potato, pulses, peas, cauliflower and yam. Any surpluses are sold to fulfill other household needs. Domesticated livestock include cattle, goat, sheep and pig, with poultry mostly reared for sale.

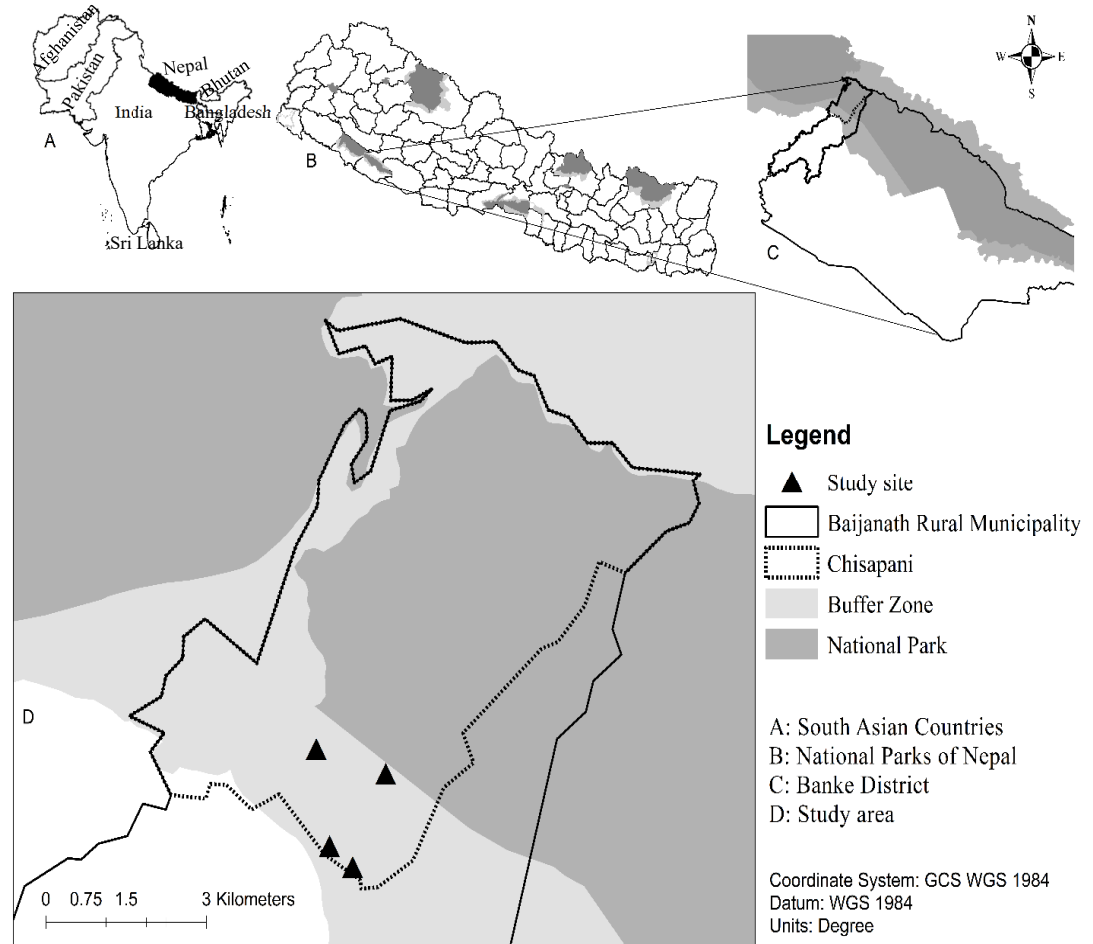


Figure 1: Map of Nepal and study area

2.2.2 Survey Design and Implementation

We followed the semi-structured survey (closed and detailed, with few open-ended questions) based on White et al.'s (2005) argument for its accuracy over fully open-ended questions. The survey obtained Institutional Review Board approval at Montclair State

University and was administered to only one member per household for standardization and consistency purposes, similar to Gardener (2012), Teorell and Svensson (2007) and Udmale et al. (2014). The consent form was read in front of the respondents and a copy of it was handed to them before administering the survey. The term household, for our study, refers to a single person or group of people who normally live in a particular housing unit and share meals together (Central Bureau of Statistics, 2012). All data generated for the damage caused by wildlife was based on the respondent's answer.

We used expert views of the park's chief-warden, as well as a literature review to select a study area that included areas that have experienced crop raiding and livestock predation and is located between 3 meters and around 1.5 kilometers from the park boundaries. The study was carried out on 10 consecutive days in July of 2017 and followed a systematic random sampling with face-to-face interviews. Alberini and Cooper (2000) and the United Nations' Department of Economic and Social Affairs (2005) have shown the effectiveness of this method within rural parts of developing countries as lower literacy levels limit the effectiveness of mail, telephone, or self-administered surveys. Within the hamlet-1 of Baijanath rural municipality, 198 households were surveyed, as 381 households were in the buffer zone and in proximity to BaNP (Figure 1). The first household was chosen randomly and every other household was chosen after that. If any household was unwilling to participate or had no occupants present, the following house

was chosen and the same process of the sampling interval was repeated from that house forward. Respondents were invited to answer the survey away from other family members to reduce their influence on responses. The survey form was in Nepali vernacular, and an interpreter was on hand to translate the respondent's answers if the respondent didn't understand or speak Nepali.

The survey was structured into two sections, with the first part focused on demographic questions and the latter on experience of HWC. The demographic questions followed the questionnaire format of the 2011 Nepal census. The survey was designed to investigate (i) if establishment of the protected status of the forest influenced the incidence of HWC more on the target population, if they have experienced any conflict, (ii) the species of wildlife with the most reported conflicts, (iii) the types of crops raided by animals, (iv) the types and number of livestock lost due to predation, and (v) the number of livestock owned at the time of conflict, which was expanded from the questionnaire of recent research conducted in the buffer zones of the Terai region by Neupane et al. (2017). All questions relating to livestock and loss counts were limited to recent events to reduce recall issues after the establishment of the park. Data was analyzed using JMP Pro 13 software. Actual measurement for verification of the claim was not carried out.

2.2.3 Theoretical Framework

Literature suggests socio-demographic characteristics such as age, gender, education level, family size, income, landholding, and employment influences the responses of people about wildlife conflict (Kaitopok, 2015; Karlsson and Sjöström, 2007; Neupane et al., 2017; Ogra, 2008). In addition, Neupane et al. (2017) argued that educated people can better understand the scope of wildlife conflict and find potential solutions. So, holding these findings, this study hypothesized that the contribution of demographic factors (age, gender, education, income, employment, landholding, and family size), wildlife species identified as causing the loss (the common leopard, the Bengal tiger, the Asian elephant, etc.), and the number of livestock lost are associated with the household's likelihood to report the conflict.

Individuals preferences can be explained by random factors based on Random Utility Theory. The literature shows use of logistic regression as a suitable analysis method when the dependent variable in a research has binary outcome like yes-no (Al-Ghamdi, 2002; Cramer, 2011; Peng et al., 2002; Sitati et al., 2005; Sreejesh et al., 2014; Stefanski and Carroll, 1985). The dependent variable for this study was “whether the respondent has reported a loss due to human wildlife conflict” coded in a yes-no binary form. The twelve explanatory variables classified into three categories were (i) demographic factors such as age, gender, education, income, employment, landholding, and family size, (ii) species to

which loss is attributed, and (iii) the number of livestock lost. The Bengal tiger, common leopard, Asian elephant, and *Macaca assamensis* (Monkey) mammals are all listed as protected species under the National Park and Wildlife Conservation Act of 1973, based on the International Union for Conservation of Nature (IUCN) red list category and criteria (Jnawali et al., 2011; The IUCN red list of threatened species, 2017). The wildlife listed in the directory of compensation relief, common Leopard, Bengal Tiger, Asian Elephant, and Wild boar (*Sus scrofa*), were considered in the cause of loss with assumption that people are more willing to report if they are confident they will be compensated. Let,

$$\pi(x) = P(Y = 1|X = x) = 1 - P(Y = 0|X = x). \quad (1)$$

Where, the probability of getting a “yes” response (Y=1) was estimated given the values of explanatory variables (x). The logistic regression model considered for our study was:

$$\pi(x) = \text{Probability}(Y = 1|X = x) = \frac{e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}}{1 + e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}}. \quad (2)$$

where, $\pi(x)$ is the probability that respondents say “yes” when asked if they reported a loss after experiencing human-wildlife conflict, α is the Y-intercept, and β is the regression coefficient. The null hypothesis states that when β -coefficient equals zero, there is no linear relationship between the response variable and explanatory factors considered in the study. The positive β -coefficients shows the positive association between the dependent and explanatory variables and the negative β -coefficients shows the negative

association between them (Agresti, 2007; Peng et al., 2002). Odds ratio was calculated by taking the exponent of the coefficient (β).

2.3 Results and Discussion

2.3.1 Incidences of HWC

Out of the 198 surveys administered, 197 were complete and experienced a conflict. One of the households had no conflict with wildlife as they did not own any land or livestock and were therefore not considered for the study. The survey done in buffer zone of BaNP revealed that villagers perceived HWC to be a major problem. Gusset et al. (2008) and Karanth et al. (2012) found that most of the HWC related to livestock depredation and crop loss were more evident in households that are located within administrative buffer zones of protected areas than households outside buffer zones. Most of HWCs involved crop damage and death of livestock, with few human casualties and little property damage. Out of 197 respondents, 54.82% (108 respondents) experienced death of livestock most often during the night time. As the study area was an agriculturally based site in proximity to the national park (3 meters to 1.5 kilometers), the proximity to field and human habitation may have resulted in the crop depredation as reported by all the respondents. The study done by Karanth et al. (2012) also found that the environmental factors like distance from the national park resulted in decreased livestock loss.

The household summary of our study (Table 1) showed that the greater percentage of respondents were people within the age range of 30-39 years old and the smallest number of respondents were 50-59 years old. The male respondents were 60.91% and the remaining were female respondents (39.09%). 91.88% of respondents had an annual income of less than \$1,160. The education level of the study area showed 37.56% were illiterate, 40.61% lacked formal education, and only 6.09% had an education above 10th grade. 63.96% of respondents had landholding size of less than 0.835 acres and 3.55% did not own land but rather had rented or worked on others' land for agricultural purposes. 55.81% of respondents had a family size of 4-6 people and only 10.15% had family size of 1-3 people.

Table 1: Summary of survey households

Variable	Variable description	Variable options	Household percentage
Age	Ordinal	a. 20-29 years old	a. 14.21
		b. 30-39 years old	b. 31.47
		c. 40-49 years old	c. 21.83
		d. 50-59 years old	d. 13.20
		e. ≥ 60 years old	e. 19.29
Gender	Nominal	a. Male	a. 60.91
		b. Female	b. 39.09
Education level	Ordinal	a. Illiterate	a. 37.56
		b. No formal education	b. 40.61
		c. $\leq 10^{\text{th}}$ grade	c. 15.74

Variable	Variable description	Variable options	Household percentage
		d. >10 th grade	d. 6.09
Income	Nominal	a. <\$1,160 b. ≥\$1,160	a. 91.88 b. 8.12
Employment	Nominal	a. Self-employed b. Employee c. Farmer d. Housewife e. Others	a. 2.54 b. 5.58 c. 69.04 d. 15.23 e. 7.61
Landholding	Ordinal	a. no land/working on others b. <0.835 acres c. ≥0.835 acres	a. 3.55 b. 63.96 c. 32.49
Family size	Ordinal	a. 1-3 persons b. 4-6 persons c. ≥7 persons	a. 10.15 b. 53.81 c. 36.04
Wild Boar	Nominal	a. Yes b. No	a. 94.42 b. 5.58
Deer	Nominal	a. Yes b. No	a. 68.02 b. 31.98
Monkey	Nominal	a. Yes b. No	a. 16.24 b. 83.76
Elephant	Nominal	a. Yes b. No	a. 16.24 b. 83.76
Porcupine	Nominal	a. Yes	a. 3.60

Variable	Variable description	Variable options	Household percentage
		b. No	b. 96.40
Black Buck	Nominal	a. Yes	a. 2.03
		b. No	b. 97.97
Bengal Tiger	Nominal	a. Yes	a. 49.24
		b. No	b. 50.76
Common Leopard	Nominal	a. Yes	a. 10.15
		b. No	b. 89.85
Other species	Nominal	a. Yes	a. 26.90
		b. No	b. 73.10
Wild birds	Nominal	a. Yes	a. 3.04
		b. No	b. 96.96
Report the loss	Nominal	a. Yes	a. 32.99
		b. No	b. 67.01

Note: (a) The land unit *kattha* was used in actual field research and was converted to acres in this report (i.e., 1 kattha = 0.0835 acres). (b) The Nepalese currency was used in the questionnaire and was converted to US Dollars using the dollar conversion value provided by Nepal Rastra Bank of Nepal at the time of the study (US \$1= NRs.103.40).

Bengal Tigers and Common Leopards were reported as the top predators of livestock by 49.24% and 10.15% of respondents respectively. These predators killed livestock such as cows, buffalos, goats, pigs, and sheep. The report prepared by DNPWC

(2017) also reported Common Leopards and tigers to be top predators responsible for 78.00% and 14.10% respectively of total conflicts reported in Nepal. The greater percentage of tiger conflicts in our study can be explained due to TAL holding the highest population density in the country. In Terai, throughout history, most conflicts have been with tigers, though our study area revealed a high level of conflict with leopards as well. This may be due to the increasing number of leopards, which consider livestock as easy prey, after the successful launch of community forestry program in the country as per Acharya et al. (2016).

The study by Sprague and Iwasaki (2006) recognized monkeys to be destructive animals in terms of crop damage around the globe. This was true in our study as well, as monkeys were reported as the cause of conflict by 16.24% of respondents. Throughout the country, 87.10% of conflict reported for crop raiding was with elephants; elephants were regarded to be the most destructive wild animal in terms of damaged crops, destruction of property, and cause of injury and death to humans (DNPWC, 2017). Parker et al. (2007) also regarded elephants to be destructive animals in Asian countries like Nepal. Furthermore, elephants are considered to be the only species reported for structural damage in Nepal at this time (DNPWC, 2017). However, conflicts with elephants in BaNP have not been documented in the literature so far, but our study showed 16.24% of respondents suffered from elephant conflicts, possibly due to the movement of elephants, whose

population is increasing, likely due to migration from adjoining Bardia National Park (BNP) as highlighted by Neupane et al. (2017).

Among the top ranked crop-raiding species, wild boars were reported as the main crop raider by 94.45% of respondents. Pandey et al. (2016) and Sapkota et al. (2014) also identified wild boars as a driver of HWC in Nepal. The study by Linkie et al. (2007) addressed that the proximity of agricultural lands to forests make them more prone to raiding by wild boars. The study area was only 3 meters to 1.5 kilometers from the forest edge, which might be the reason the wild boar is a problematic species. Deer were reported by 68.20% of respondents while porcupines and blackbucks were reported by only 3.50% and 2.03% of respondents, respectively. As these species were not listed as protected species and no relief was distributed for the loss incurred by them, these were not taken as a variable for our model.

2.3.2 Likelihood to report the loss

Out of all respondents who experienced HWC, only 32.99% (65 respondents) had reported losses to authorities, while 67.01% (132 respondents) had not. The 65 respondents had reported only the livestock loss, and none of the villagers reported the crop loss despite the compensation scheme for crops/stored grain loss. The study done by Karanth et al. (2012) in Central Indian Protected area also found that people experiencing HWCs mostly report the livestock loss over crop loss, and a higher percentage of livestock loss victims

get compensation than the crop loss. In addition, the author reported that thirty percent of the total households (735) surveyed reported livestock loss and only 34% of total victims reported the loss. This shows that not reporting the loss to the authorities is prevalent in other countries besides Nepal.

Table 2: Results of logistic regression

Variables	Coefficient (β)	Standard Error (SE)	Level comparisons
Age	1.63**	0.65	30-39 vs 20-29
	-0.99	0.54	40-49 vs 30-39
	0.56	0.68	50-59 vs 40-49
	-1.45	0.79	≥ 60 vs 50-59
Gender	-0.53**	0.26	Male vs Female
Education	0.04	0.49	No formal education vs Illiterate
	0.73	0.60	$\leq 10^{\text{th}}$ grade vs No formal education
	-0.35	0.93	$\geq 10^{\text{th}}$ grade vs $\leq 10^{\text{th}}$ grade
Income	-0.67	0.87	$\geq \$1,160$ vs $\leq \$1,160$
Employment	-0.47	1.22	Self Employed
	0.58	0.72	Employee
	-0.47	0.49	Farmer
	-0.84	0.66	Housewife
Landholding	0.71	1.21	< 0.835 vs no land/working on others
	-0.36	0.43	≥ 0.835 acres vs < 0.835
Family size	0.65	0.71	4-6 persons vs 1-3 persons
	1.14***	0.43	≥ 7 persons vs 4-6 persons
Common Leopard	0.83**	0.34	Yes, vs No
Tiger	0.63***	0.22	Yes, vs No

Variables	Coefficient (β)	Standard Error (SE)	Level comparisons
Elephant	0.58**	0.27	Yes, vs No
Wild Boar	-0.07	0.40	Yes, vs No
No. of dead livestock	0.20	0.12	-----

Note: ***and ** indicates significance at $\alpha=0.01$ and $\alpha=0.05$ respectively. A positive coefficient (β) indicates increased likelihood while the negative coefficient ($-\beta$) indicates reduced likelihood.

The logistic regression model (Table 2) showed that the respondents within the age group of 30-39 years old were more likely to report the loss while other variables were held as constant. This opposed our assumption of likelihood to report the loss by younger people as respondents of the age group 20-29 years old were less likely to report the loss. Those with a family size of ≥ 7 persons were statistically significant and were more likely to report the loss. This supported our hypothesis of likelihood to report the loss with a unit increase in family size. We hypothesized that with the increase in number of dependents, the respondent who bore the loss would report the loss to balance the economic fluctuation that arises due to HWC. The uses of space, work, status, and identity were associated with the difference in disproportionate burden of HWC effects within different genders (Ogra, 2008). The patriarchal society of Nepal considers males to be the decision makers in any household; we hypothesized that the male population was more likely to report the loss due

to their position in the family, but the study showed that although this was significant factor, they were less likely to report the loss than the female population (negative β -coefficients).

Based on the directory for relief from wildlife damage, we hypothesized that the respondents who bore conflict due to the wildlife listed in the compensation distribution area (Bengal tiger, common leopard, Asian elephant, and wild boar) were more likely to report the loss than with unlisted wildlife. Loss due to Bengal tigers, common leopards, and Asian elephants influenced the likeliness to report the loss, which supported our hypothesis. However, the wild boar was found most frequently responsible for loss but was not a statistically significant factor for reporting loss.

Education was not a statistically significant factor in our model; we assume that this may be due to lack of variation in our data, as 78.17% of total respondents were either illiterate or had no formal education. The study by Karanth and Nepal (2011) in Nepal showed that among the households that resided alongside the national parks, 53% of households had substantial loss of income. Based on this finding, we hypothesized that the households who have lower income levels would be more likely to report the loss as even a small portion of the agricultural or livestock loss could worsen their livelihood. However, income was also not statistically significant, which could be due to the lack of variance within the respondents, as 91.88% of the respondents had an annual income < \$1,160. In

addition, employment was not statistically significant to influence the likelihood of reporting loss. This may be due to overrepresented professions in the survey, with 69.03% reporting they were farmers, followed by 15.22% as housewives, and only 5.60% employed in different organizations. Furthermore, landholding was also not statistically significant and opposed our hypothesis that lesser land owned for farming would result in reporting the loss as they have no surplus agricultural products to sustain their living.

Our study showed that all the 197 respondents considered for the logistic regression reported experiencing HWC at least once in terms of crop and/or livestock loss after the establishment of the National Park. According to the residents, they use to experience some extent of conflict infrequently before establishment of the park, conflict became much more common after its inception. The respondents reported all varieties of crops were raided by wildlife. The respondents perceived that the protected wildlife is national property, and wildlife threats are imposed upon the locals without the government considering their concerns. BaNP was established without the consultation from the villagers (Ayadi, 2011). Additionally, according to the respondents, paddies are raided mostly during the winter while vegetables are raided year-round. Crop raid has been a nuisance to the farmers and has occurred every year. Conservation of wildlife in human dominated landscapes must consider the social and economic implications when wildlife forages on crops, damages properties, or poses serious threat to human safety (Treves et al., 2006). Although there is

no literature mentioning human-elephant conflict in BaNP, our study recorded this conflict. People living in the vicinity of elephant habitats bear disproportionate costs of elephant conservation due to increased human-elephant conflicts and develop negative attitudes towards elephant conservation (Parker et al., 2007). The elephant conflict in the study area could be substantially altered in the initial phase by switching the crops like maize with green chili peppers, which was argued by Parker and Osborn (2006) to be less palatable for elephants and thus can reduce conflict.

The households in our study area did not report agricultural loss despite experiencing loss all year around. This might be because of some loopholes regarding the compensation package (Pant et al., 2015). Thapa (2016) mentioned that HWC has been a national issue in the country, and despite launching the compensation scheme and buffer zone user community group, the aim to reduce the conflict has not been achieved. This might be due to scenarios like in our study where people having conflict are not reporting loss. Furthermore, the annual report of DNPWC revealed that in the period of 1998 to 2015, people reported 177 human losses and 97 injuries, which might be a low estimate as such incidents are not always reported and the government lacks proper data management practices (Bhattarai et al., 2017). This study has highlighted the factors that influence the likelihood to report the loss; however, the causes that hinder those effected from doing so will be our next priority in future research.

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3: Flood Impacts and Trauma: A case study of Banke District, Nepal

3.1 Introduction

Nepal, a developing country in South Asia, is among the 20 most disaster-prone countries in the world and is ranked 30th in terms of flood risk (Nepal Red Cross Society, 2015). Among developing countries, Nepal is ranked 11th in disaster vulnerability and has been identified as a global “hotspot” for natural disasters (US Agency for International Development, 2018; Dilley et al., 2005). Floods and landslides are the most damaging among natural disasters in terms of economic damage and causes of death in the country (Gautam and Phaiju, 2013). Nepal is particularly vulnerable to precipitation-related issues due to varying altitude (60m to 8850m above sea level) and over 6,000 rivers and rivulets rushing down the steep mountain slopes of the Himalayas (Karki et al., 2011). Annually, it is estimated that approximately 358 human lives are lost, 14,033 households are affected, and millions of Nepalese Rupee are lost due to water induced disasters like floods, landslides, and avalanches in Nepal (Department of Water Induced Disaster Prevention, 2014; Gautam and Phaiju, 2013).

Because of its unique set of geographical features, Nepal is at a high risk for flash floods and experiences them regularly. Flash floods are hazardous and usually unpredictable, and thus often result in a considerable loss of life and property (Ashley and Ashley, 2008). Flash floods have a high destructive capacity in a very short period of time

and can occur in small rivers as well as the large ones (The Associated Programme on Flood Management, 2007). For example, a flash flood that originated in the Seti River of the country on the 5th of May 2012 swept away the settlement of Kharapani, where 40 people were found dead, 31 people went missing, and 23 buildings were completely swept away, destroying lives and livelihoods (Sharma et al., 2015).

These losses are not only physical and tangible; emotional trauma accentuates the overall physical loss suffered by such extreme natural disasters. A traumatic event is considered “any event that puts a person or someone close to him/her at the risk of serious harm or death” (The Mental Health Foundation, 2018). Thus, surviving a flood can often constitute traumatic experience as it affects both the physical well-being of the victim and can affect short- and long-term mental well-being (Tapsell and Tunstall, 2000). Natural or climatic hazards can result in psychological and mental health issues associated with loss, disruption, and displacement (Walker-Springett et al., 2017; Few, 2007). The primary and secondary stressors after a flood event result in psychological or emotional trauma (Stanke et al., 2012). Primary stressors include injury or property loss, which arise during the flood event and are experienced at the time of the event. However, secondary stressors follow as a result or an aftermath of primary stressors and include infrastructure failure, challenges in returning to normality, and failure to adjust to new living circumstances due to disasters (Lock et al., 2012; Stanke et al., 2012; Carrol et al., 2009). Consequently, secondary

stressors are also indirectly related to economic stress associated with recovering, which occurs as people try to repair their lives, properties, and relationships (Overstreet et al., 2010).

Emotional well-being can be affected long after the aftermath of a flood, influenced by following evacuation and recovery processes, cleaning up, repairing the damaged structures, dealing with builders, and filing insurance claims (Carrol et al., 2009; Thrush et al., 2005; Ohl and Tapsell, 2000). Socio-economic factors along with flood severity have also been shown to be connected to the prevalence of mental health disorders (Lamond et al., 2015). Thus, the emotional trauma that results from secondary stressors needs to be better understood and addressed. This problem is even more acute for countries like Nepal, where even some of the physical damages are not adequately studied.

Many studies related to the aftermath of disasters have addressed the relationship between primary stressors and psychological distress, anxiety, depression, and even suicidal ideation (Arnberg et al., 2013; Stratta et al., 2012). However, literature lacks sufficient research based on secondary stressors, which play a significant role in recovering from trauma after any natural disaster. To address this research gap, this study aims to explore the relationship between emotional trauma and demographic characteristics, types and prevalence of loss, and the socio-economic costs of related damage after a flood.

3.2 Methods

3.2.1 Study Area and Survey Design

Although Nepal has experienced severe and recurring flood events throughout its history, there have been few relevant peer-reviewed studies for these phenomena since 1990 (Rufat et al., 2015). For over three decades, government reports have recorded the disasters and calculated the related impacts such as the number of deaths and loss of property (Tuladhar, 2012). While it is customary for government and the relevant bodies to record the physical impacts of floods, the trauma, such as the intrinsic sense of security and control of the population that results from floods, is seldom measured and addressed. Moreover, the Government of Nepal spends only about 1% of its budget on mental health out of the already meager allocation of the national budget to the health sector, reported to be less than 3% (Regmi et al., 2004). However, the psychological distress in survivors of floods tend to exacerbate physical illnesses and is known to leave lasting emotional effects on the lives of ordinary people (Alderman et al., 2012; Kesselman, 1986). This research was conducted to evaluate the role of demographic and socioeconomic factors, as well as the types of losses, in explaining the likelihood of an individual's recovery after a flooding disaster in Nepal.

Several villages of the Terai region of the country are frequently affected by flooding in the lower West Rapti River (WRR) Basin, where extreme flood events were

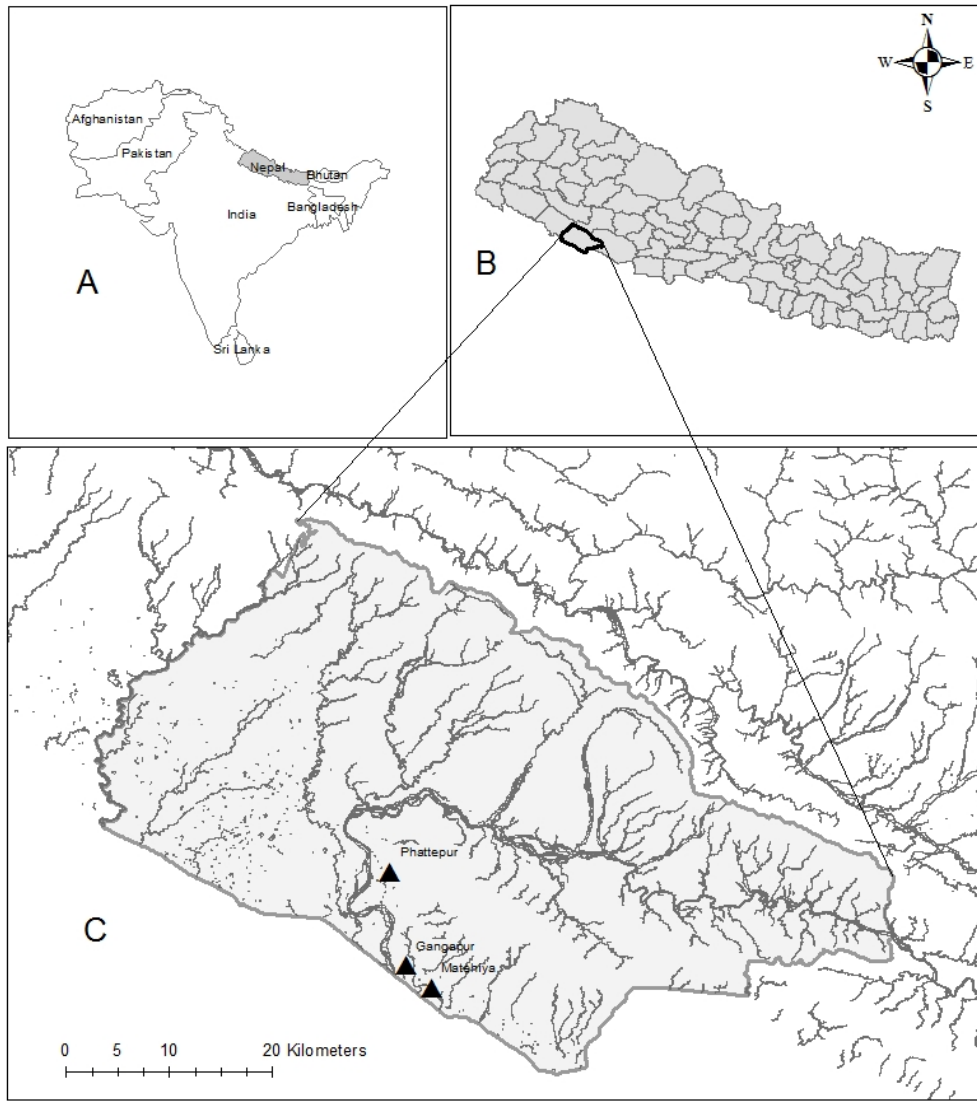
recorded in 1977, 1981, 1983, 1989, 1998, 2006, 2007, 2009, and 2012 (Gautam and Phaiju, 2013). The region is located in the southern belt of the country that occupies 17% of the total land area and is at the northern edge of the Indo-Gangetic plain (Adhikari, 2013). The region has numerous rivers and streams, as all the rivers of Nepal flow down from the highest mountainous region and accumulate in Terai, which is mostly flat terrain, making it more prone to hydrological risks (Dewan, 2015). Within the region, the study area was located in the Banke district of Nepal, a part of the lower WRR Basin, near the Nepal-India border. The WRR basin is one of the most flood-prone river basins in Nepal (Talchabhadel & Sharma, 2014; Gautam and Phaiju, 2013).

The total population of the Banke district was 491,313 as per the 2011 census (Central Bureau of Statistics, 2012). In August 2014, several districts of the Terai region were flooded, and the district was among the worst affected districts as per the official report prepared by the International Federation of Red Cross and Red Crescent Societies (IFRC) (2015), which reported that in the Banke district alone, 15 people died, 5 went missing, 2 were injured, 2,889 families were displaced, 11,699 families were affected, 2,889 houses were fully destroyed, and 8,810 houses were partially destroyed/damaged.

In order to collect data about the effects of the flood, we used a survey. The survey comprised of multiple choice questions as well as open-ended questions following a semi-structured format which tend to be better than having open-ended questions alone (White

et al., 2005). The survey instrument was approved by the Institutional Review Board of Montclair State University and administered to one occupant per household totaling in 443 respondents. The survey had questions related to the involvement of a Community Forest User Group (CFUG) for flood resilience. Only the households within a 2 km distance of the river that were flooded and involved with a CFUG were considered based on the time and resource constraints. As all the villagers were active in a CFUG, only 50 households from each user group were considered.

A total of six forest user groups were surveyed from the Phattepur Village Development Committee (VDC): Rapti Pidit Tatha Gulari, Siddhababa, Sidheswari, Bhagawati, Sadabahr, and Sri Ramjanaki forest user groups. Gangapur VDC had only two forest user groups, Sri Ramjanaki and Durga Mata. Although Matchiya VDC had two forest user groups, only the settlements of Ganapati forest user group were flooded and were surveyed while the Gaji forest user group was not considered as it was a non-flooded settlement area. The 50 households from each forest user group were selected following systematic random sampling for face-to-face interviews, as this has been proven to be an effective method in the rural part of developing countries where the literacy level is limited (Alberini & Cooper, 2000). Limited involvement of the community forest group for resilience was found in all villages, thus this variable was not considered in the study.



Legend

- ▲ Study sites
- ▬ Rivers
- ▭ Banke District

A: South Asian Countries
 B: Nepal
 C: Study Area

Coordinate System: GCS WGS 1984
 Datum: WGS 1984
 Units: Degree

Figure 2: Map of Nepal and study area

The study was carried out through the months of June and July 2017, approximately three years after the 2014 flood event. We surveyed 293 respondents from Phattepur, 100 respondents from Gangapur, and 50 respondents from Matehiya village development committees (VDCs) to collect the responses. Seven households from Phattepur were not included as the household members were not present at the time of the survey. We considered households as per the Central Bureau of Statistics (CBS) of Nepal's report of 2012, which defines a household as a group of people living and sharing meal together.

The survey was structured in two sections, the first part focusing on demographic attributes and the second part focusing on social and economic costs of damage. The survey form was printed in Nepali vernacular, the national language, and an interpreter was on station to translate the survey into the local language if the respondent did not understand or speak Nepali. The demographic questions followed the questionnaire format of the 2011 Nepal census (CBS, 2012). The social and economic cost of damage questions followed the binary option format (yes/no). For example: if a person had lost his/her family member in the flood, he/she could choose the option "yes," and if no members were lost, he/she could choose option "no". The survey was designed to capture respondents' age, gender, education, income, employment, landholding, and belongings lost due to flood such as family, house, livestock, agricultural land, or other assets. JMP Pro 13 software was used for statistical data analysis and logistic regression was used to build the model.

3.2.2 Theoretical Framework

Demographic factors like age, gender, and income are considered principal drivers for a population's ability to prepare for, respond to, and recover from damaging flood events (Rufat et al., 2015). For example, the aftermath of flooding and other natural disasters has been shown to disproportionately affect females, the elderly, and children in terms of psychological and physical health effects (Kuwabara et al., 2018; Lowe et al., 2013). Older individuals are more vulnerable to Post Traumatic Stress Disorder (PTSD) as they are dependent on adults of working age (Stanke et al., 2012; Zhang et al., 2011). Therefore, we hypothesized that the elderly, as compared to younger adults, are less likely to recover from trauma due to difficulty in performing household chores and earning a living. We also hypothesized that employed individuals are more likely to recover from trauma than those who were unemployed or relied on agriculture or livestock for their livelihoods. We also hypothesized that females are less likely to recover from trauma due to their disproportionate level of household responsibilities based on the unequal social construction of gender roles in homes in developing countries (Fordham, 1998; Steinglass and Gerrity, 1990).

We hypothesized that people with higher incomes are more likely to recover from trauma than those who are on the lower spectrum of income, as household income can act as a predictor for psycho-social symptoms (Lamond et al., 2015). Historically, people with

lower income tend to be more impacted by natural disasters as they tend to have lower adaptive capacity, less protection, fewer reserves, fewer alternatives, and generally are more dependent on primary production or agriculture (Perera et al., 2015).

Furthermore, we hypothesized that people who had achieved an academic degree or had a schooling up to a high school degree would be more likely to recover from trauma, as they could find jobs more easily in comparison to those who had no formal education or were illiterate. In addition, educated individuals are presumed to be more empowered and adaptive when responding to, preparing for, and recovering from disasters (Hoffmann and Muttarak, 2017; Muttarak and Lutz, 2014). People who own a smaller fraction of land would comparatively suffer in higher intensity if the land is inundated. In comparison, people who own larger portions of land might have higher chance of land availability in adverse conditions and can thus have a better chance of continuing their livelihoods and starting the physical and mental rehabilitation process. So, we hypothesized that people with more land would be more likely to recover from trauma. Strong emotional attachment to one's house is a natural human trait and thus can cause severe stress if the place which one calls home is damaged or destroyed, (Tapsell, 2009; Verger et al., 2003). Furthermore, emotional responses such as fear of death or the number of casualties or losses amplifies severity towards the traumatic event after a disaster, can have a significant effect on post-event outcomes that result in distress (Tapsell, 2009; Briere and Elliott, 2000). Thus, we

hypothesized that the people who had lost belongings and/or family members would be less likely to recover from trauma.

People who have gone through negative changes like unemployment, damage to their houses, insufficient social support, and other changes in the course of post-disaster recovery are more likely to incur mental health problems than people who have not experienced these changes (Overstreet et al., 2010). Thus, based on the aforementioned literature analysis, this study used the dependent variable, “Have you fully recovered from the emotional trauma due to the recently experienced flood,” coded in yes-no binary form. In this study, the term “emotional trauma” refers to PTSD that arises due to the psychological distress that develops while recovering in the aftermath of a flood.

We selected the yes/no option for this variable because emotional trauma is a subjective term in itself; for example, a person owning 10 acres of land might not experience emotional trauma if he lost 1 acre to a flood event as he has 9 acres of land remaining for his livelihood, but if this same loss befalls someone with only one acre of land, this loss represents the entirety of their livelihood and can be expected to be more devastating. If the respondents responded “yes” to this question, it meant that they were no longer suffering or had recovered emotionally or psychologically from the loss they had during/after the flood event at the time of study. If the respondents responded “no” to the question, it meant that they have not recovered from the trauma.

Logistic regression was used as the main statistical tool, as it represents a suitable method for analyzing models with a dependent variable of binary outcome (Agresti, 2018; Sreejesh et al., 2014). The eleven predictor variables included to explore the relationship with the dependent variable were classified into two categories: (i) demographic factors, such as age, gender, education, income, employment, and landholding, and (ii) social and economic costs of damage such as family, house damaged/destroyed, livestock, agricultural land, and other assets lost. The variable description is elaborated in Table 3. The logistic regression follows a sigmoid curve where the response is the logit, the natural logarithm of an odds ratio (Peng et al., 2002).

$$\pi(x) = P(Y = 1|X = x) = 1 - P(Y = 0|X = x) \quad (3)$$

Given the values of predictor variables (x), the probability of getting a “yes” response ($Y=1$) follows the following logistic regression model (Peng et al., 2002) where, $\pi(x)$ is the probability that respondents will say “yes”, α is the Y-intercept, and β is the regression coefficient (Agresti, 2018):

$$\pi(x) = \text{Probability} (Y = 1|X = x) = \frac{e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}}{1 + e^{\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n}} \quad (4)$$

The null hypothesis states that if β equals zero, there is no linear relationship between the dependent and the explanatory variable while other variables are held constant. So, if the value of β is greater than zero, the relationship is said to have positive association

and vice-versa (Agresti, 2007). Odds ratio was calculated by taking the exponent of the coefficient (β).

3.3 Results

All 443 respondents surveyed reported the August 2014 flood event to be the most recent disaster that had affected their lives. The study results show that the people between the ages of 30-39 years old had the highest representation, and people aged 60 years or older had lowest representation (Table 3). However, the 2011 census had the highest representation of the age group 20-29 (34%) and the lowest for the age group 50-59 (11%) (CBS, 2012) since the study area consisted of only three villages out of 47 villages/municipalities present in the district. Among the respondents, 66.82% were male and 33.18% were female. However, the 2011 census report reported 50.17% were male in the study area and 49.83% were female. The percentage difference in the census report and this study may be due to the age restriction that we imposed on respondents (adults) while the census included the entire population starting from newborn children.

In our survey, 45.37% of respondents were illiterate, while 39.73% had no formal education, and only 14.90% had an academic education at the high school level or above. This is acceptable given that the 2011 census report of the country showed 62.40% of population above 5 years old were able to read and write in the Banke district.

Table 3: Summary of survey households

Variable	Variable description	Variable options	Household percentage
Demographic factors			
Age	Ordinal	a. 20-29 years old	a. 20.54
		b. 30-39 years old	b. 30.47
		c. 40-49 years old	c. 22.12
		d. 50-59 years old	d. 15.12
		e. ≥ 60 years old	e. 11.74
Gender	Nominal	a. Male	a. 66.82
		b. Female	b. 33.18
Education level	Ordinal	a. Illiterate	a. 45.37
		b. No formal education	b. 39.73
		c. $\leq 10^{\text{th}}$ grade	c. 8.35
		d. $> 10^{\text{th}}$ grade	d. 6.55
Income	Nominal	a. $< \$1,160$	a. 93.91
		b. $\geq \$1,160$	b. 6.09

Variable	Variable description	Variable options	Household percentage
Employment	Nominal	a. Self-employed b. Employee c. Farmer d. Housewife e. Others	a. 5.19 b. 4.51 c. 64.11 d. 18.74 e. 7.45
Landholding	Ordinal	a. no land/working on others b. <0.835 acres c. ≥ 0.835 acres	a. 8.35 b. 67.27 c. 24.38
Social and Economic costs of damage/flood impacts			
Loss of Family member	Nominal	a. Yes b. No	a. 1.58 b. 98.42
House destroyed/damaged	Nominal	a. Yes b. No	a. 35.21 b. 64.79
Livestock loss	Nominal	a. Yes b. No	a. 14.22 b. 85.78

Variable	Variable description	Variable options	Household percentage
Agricultural land loss	Nominal	<i>a.</i> Yes	<i>a.</i> 92.78
		<i>b.</i> No	<i>b.</i> 7.22
Loss of other assets	Nominal	<i>a.</i> Yes	<i>a.</i> 61.63
		<i>b.</i> No	<i>b.</i> 38.37
Emotional Trauma	Nominal	<i>a.</i> Yes	<i>a.</i> 10.84
		<i>b.</i> No	<i>b.</i> 89.16

Note: (a) The land unit *kattha* was used in actual field research and was converted to acres in this report (i.e., 1 kattha = 0.0835 acres). (b) The Nepalese currency was used in the questionnaire and was converted to US Dollars using the dollar conversion value provided by Nepal Rastra Bank of Nepal at the time of the study (US \$1= NRs.103.40).

The majority of respondents (93.91%) reported annual household income less than \$1,160. Furthermore, 64.11% of the respondents represented farmers, 5.19% were self-employed, and 4.51% were employed. While 8.35% of respondents said they had no piece of land and were working on others' lands, 67.27% of respondents said they have landholding area less than 0.835 acres followed by 24.38% with landholding more than or equal to 0.835 acres. The household statistics of the survey revealed that the majority of

respondents were agriculture dependent, had comparatively low academic achievement, and limited income.

The social and economic cost of damage part of the survey, revealed that 1.58% of respondents lost a family member in the 2014 flood. In addition, 35.21% of the respondents reported that their house was destroyed/damaged, 14.22% reported livestock loss, 92.78% reported agricultural land loss, and 61.63% reported loss of other assets. The other assets mentioned by respondents included loss that could be either money in cash, utensils, clothes, documents, keepsakes, and other various items that had significant value.

Out of the 443 respondents, only 10.84% reported that they had recovered from the flood trauma. Thus, the ones who reported not having recovered from trauma represented 89.16% of the respondents. We explored likelihood to recover from emotional trauma, the demographic attributes as well as the factors related to social and economic cost of damage/flood impacts through logistic regression model , whose results are delineated in Table 4 below.

Table 4: Results of logistic regression

Variables	Coefficient (β)	Standard Error	Level comparisons
Age	-0.41	0.54	30-39 vs 20-29 years old
	0.09	0.53	40-49 vs 30-39 years old

Variables	Coefficient (β)	Standard Error	Level comparisons
	-1.34	0.83	50-59 vs 40-49 years old
	1.02	1.02	≥ 60 vs 50-59 years old
Gender	0.004	0.30	Female vs Male
Education	-0.43	0.45	Illiterate
	0.40	0.40	No formal education
	-0.52	0.64	$\leq 10^{\text{th}}$ grade
Income	0.64	0.93	$< \$1,160$ vs $\geq \$1,160$
Employment	0.50	0.60	Self-employed
	-0.19	0.85	Employee
	-0.003	0.50	Farmer
	0.01	0.70	Housewife
Landholding	-0.80	0.90	< 0.835 vs no land/ working on others
	1.50****	0.45	≥ 0.835 acres vs < 0.835 acres
Social and Economic costs of damage/flood impacts			
Loss of family member	-0.62	0.80	Yes vs No

Variables	Coefficient (β)	Standard Error	Level comparisons
House damaged/ destroyed	-0.80***	0.30	Yes vs No
Livestock loss	-1.00**	0.43	Yes vs No
Agricultural land loss	-1.60***	0.30	Yes vs No
Loss of others assets	-0.93***	0.22	Yes vs No

Note: ***and ** indicates significance at $\alpha=0.01$ and $\alpha=0.05$ respectively. A positive coefficient (β) indicates increased likelihood while the negative coefficient ($-\beta$) indicates reduced likelihood.

For the variable landholding, the odds of recovering from trauma was statistically significant for respondents who had landholding size of ≥ 0.835 acres when compared with the respondents with landholding size < 0.835 acres. Also, the positive coefficient of 1.50 showed increased likelihood to recover from trauma if the respondents possessed larger land parcels. Although statistically significant, a negative coefficient of -0.80 revealed the reduced likelihood to recover from trauma when a respondent had experienced a damaged/destroyed house. Furthermore, the odds ratio of 0.22 for respondents who reported damaged/destroyed houses showed lower odds of recovering from trauma. Similarly, the coefficient for the variable representing the respondents who lost their

livestock were found to be statistically significant, and a negative coefficient of -1.0 showed reduced likelihood for these people to recover from trauma. The odds ratio of 0.14 for the variable capturing the respondents who had lost their livestock to flooding had lower odds of recovering from trauma.

In addition, the variables capturing the respondents who lost their agricultural land and other assets were also found to be statistically significant. The negative coefficients for both variables suggest the reduced likelihood to recover from trauma when a respondent had experienced loss of agricultural land or other assets. The odds ratio of 0.04 for the variable of agricultural land loss and 0.16 for the variable of loss of other assets also showed that the respondents who lost their agricultural land or other assets to the flooding had lower odds of recovering from trauma.

3.4 Discussion

To the best of our knowledge, this study is the first one that explores the emotional trauma based on secondary stressors caused by the flooding in Nepal. The study results suggest that the flood event disrupted the normal life and daily activities of the respondents, which was further exacerbated by damages to infrastructure and agricultural land leading to increased economic burden.

The study shows that the respondents who had a land size of ≥ 0.835 acres were more likely to recover from trauma comparatively to the respondents who owned less land.

This finding aligns with the research by Brouwer et al. (2007) in Bangladesh, who found that the lack of landholding and inequality in income to be associated with higher flood exposure. However, we did not find any supportive literature that details the relationship of this variable with the trauma. Our study found landholding to be one of the most important factors that can cause trauma.

The study also found that the respondents who lost property, including their house, livestock, agricultural land, and other assets were less likely to recover from trauma compared to respondents who did not lose their belongings. The study findings support the argument of Tapsell (2009) who found a link between having homes that were damaged/destroyed and experiencing casualties and loss of assets. Furthermore, various studies have also shown association between trauma and property damage (Galea et al., 2008; Neria et al., 2008; Marshall et al., 2007; Briere and Elliott, 2000).

In the study area, approximately 94% of the villagers reported to have income less than \$1,160 annually, suggesting the lower economic status of the villagers. Around 92.78% of respondents reported the loss of agricultural land; because the people residing in these study areas were economically dependent on agriculture (with approximately 64% being a farmer, or on labor work or daily wages for their basic needs), a major flood event could have resulted in emotional trauma to the flood victims for several years after the event. Furthermore, our study findings are in conform with the argument of Parry et al.

(2001) that the predominance of agriculture, heightened exposure to extreme events, and scarcity of capital for adaptation measures, tend to be the main factors that makes developing countries more vulnerable to disasters like flooding.

The demographic variables age and income were not found to be statistically significant in our study. This was contrary to expectations, as we hypothesized younger respondents would have increased likelihood to recover from trauma than the other age groups. In addition, the hypothesis that people with higher income have a higher likelihood of recovering from trauma was also not supported. However, this is not surprising as others like Verger et al. (2003), found these variables to be statistically insignificant with trauma even after five years of a flood in Southeastern France. Our study, which was conducted approximately three years after the 2014 flood, did not find these variables to have statistically significant impacts . Others on the contrary, such as Bland et al. (2005) found the relationship between a natural disaster (earthquake) and psychological distress even after 14 years of an occurrence, and Norris et al. (1999) found psychological distress to be persistent after 30 months of hurricane Andrew.

In addition, gender was not statistically significant in our study. Other studies have shown that the female demographic is more vulnerable than the male demographic, as well as more likely to suffer psychological distress/trauma (Overstreet et al., 2010; Tunstall et al., 2006; Norris et al., 2002; Lee and Young, 2001; Fordham, 1998; Steinglass and Gerrity,

1990). The study done by Kuwabara et al. (2008) noted psychological distress in females immediately after the earthquake incident, but did not find the presence of distress after five months. On the contrary, a study conducted approximately after six months following the flooding in the United Kingdom found higher mean scores on trauma for females than males (Mason et al., 2010). A longitudinal study between the relationship of trauma and female gender might overcome the contradictory results of different studies done across the globe.

The variable that captured respondents with different ranges of income were also not statistically significant in our study. This was contrary to expectation as literature suggest that lower income household tend to be more vulnerable to natural disasters (Perera et al., 2015; Verger et al., 2003). The insignificance for this variable in our study could be due to the lack of variance in survey data as 93.91% of respondents reported annual household income to be less than \$1,160 annually. The hypothesis that people who had higher academic achievement would be more likely to recover from trauma came out as insignificant as well. This might be due to the higher percentage of respondents being either illiterate or without formal education. On the contrary, the well-educated population were found to suffer lower disaster impacts and were able to recover faster when compared with the less educated population after a disaster (Muttarak and Lutz, 2014; Frankenberg et al., 2013).

Furthermore, the variable of family loss due to the flood was not statistically significant with emotional trauma in our study, though this variable was found to be a risk factor to develop trauma after a disaster (Verger et al., 2003; Briere and Elliott, 2000). A family/relative loss can obviously be a highly traumatizing event in anyone's life, and the loss in itself makes it harder to recover from trauma. However, since only 1.58% of the respondents reported that they had lost a family member, we may have too small of a sample to capture significance.

The study revealed that, except for the variable of landholding size, the demographic factors did not play any role towards the likelihood to recover from emotional trauma after a flooding event. There are potential limitations which should be taken into consideration while interpreting the findings of this study; we did not assess any mental health status questionnaires as used by other authors to find out the specific types of PTSD symptoms which might have resulted in the insignificance of demographic variables towards likelihood to recover from trauma. In addition, due to time constraints we were not able to consider all of the flood victims including the ones who migrated after the flood event or were displaced.

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4. Conclusion

Nepal has been identified as a biodiversity hotspot, and is also known to be a natural disaster prone country. Compared to other studies which deal with finding the impact of HWC and the physical damage aftermath from a natural disaster, this research has focused on identifying factors that influence the likelihood to report the loss from such HWC impacts, and the likelihood to recover from emotional trauma from such disastrous events. By understanding the underlying causes, we hope to provide a foundation to better design policies to ensure positive outcomes within affected communities.

Recently, Nepal has done tremendous work to protect wildlife by successfully doubling the Bengal tiger population, ending one-horned rhino poaching, and outlawing trade of animal skins and furs. However, the increased wildlife population has had unintended negative impacts on people residing within buffer zones of protected habitats and forested areas. To address these concerns, in the 1990s, the government launched compensation schemes which provided financial resources to compensate for property loss and human injury/death due to wildlife, if reported. However, as seen in many developing countries, the likelihood of reporting loss is very low due to a number of conditions impacting access and awareness.

This research highlighted the incidences of human wildlife conflict in a buffer zone of Banke National Park (BaNP), and provides insight to the factors that influence

likelihood of reporting loss. We surveyed 198 people from the buffer zones of BaNP, and found that the majority of respondents were reluctant to report their loss, despite the fact that they could have received compensation. The demographic variables like age, gender, family size, and the cause of loss from different protected wild animals were associated to influence the likelihood of reporting the losses arising from HWC. Based on these findings, we can conclude that the factors that influenced the likelihood to report loss should be addressed, as villagers whose livelihood depends on smallholder livestock systems and surplus crop sales might bear increased socio-economic vulnerability if their loss is not addressed.

Increased incidence of HWC has greatly affected communities' feelings towards wildlife, putting negative pressure on conservation efforts. Individuals may feel compelled to hurt wildlife and their habitats, which is an issue from both environmental and economic (tourism) perspectives. Thus, if the factors associated with likelihood to report the loss are taken into consideration while formulating/implementing compensation policy guidelines, or any policy related to protected areas, HWC can be mitigated to some point. Policy design is especially important to address preventative strategies within villages found near national parks and protected areas. While this study was localized to BaNP, it can be translated to other regions of Nepal with villages near protected areas, and the results can

be considered when designing policy and conservation awareness education programs to mitigate or cease HWC in the near future.

Another great concern in Nepal is the sensitivity to extreme flooding, which can be particularly destructive to the large population relying on agriculture for their livelihood. This thesis aimed to address the emotional trauma associated with such events, by surveying residents within three villages - Gangapur, Phattepur, and Matehiya which have faced recurrent flooding events since the 1990s. These villages have suffered from problems like river bank cutting, which swept away parts of the Matehiya village, which caused villagers to abandon their homes and now unusable agricultural lands.

The study findings showed that the August 2014 flood was destructive in terms of physical and monetary loss, and psychological distress. As one can expect, human suffering and property damage was a common theme across all of the affected areas. Furthermore, the villagers were vulnerable due to the flooding events, as majority of the respondents were farmers, lacked sufficient income, or had minimal land ownership. This research highlighted the factors that can help explain the likelihood of recovering from trauma after natural disasters like extreme flooding. The demographic variable that was statistically significant for likelihood to recover from trauma was as landholding, and the statistically significant socio-economic variables were damaged/destroyed house, loss of livestock, loss of agricultural land, and loss of other assets. We found that survey participants that had

larger land size were, comparatively, more likely to recover from trauma than the people with lesser land area. Furthermore, respondents that had ensured damaged/destroyed assets from the flood were less likely to recover from trauma. Our study findings were based on the secondary stressor, trauma, which is indirectly related to economic stress associated with re-building, and arises as people try to recover their lives, properties, and relationships. While other studies on trauma focus on general health questionnaires and primary stressors after a disaster, our research is novel and insightful towards understanding long-term recovery impacts.

Given the fact that the country frequently suffers from natural events like landslides, mudflows, earthquakes, and flash floods, this research hopes to inform the government authorities of Nepal on moving towards an inclusive structure to address the overall well-being of the individuals suffering from trauma in the aftermath of disaster events. While the government may prioritize other needs, its negligence in acknowledging emotional trauma due to disastrous event should be addressed. The findings of this survey can be useful to administrators and policy makers of Nepal in order to plan and implement better strategies for the human-wildlife conflict persistent communities and flood-affected communities.

As with other studies, there are potential limitations in this research which should be taken into consideration while interpreting the findings of this research. We were unable

to pretest the study. For the HWC study, we did not validate the reporting of loss with the official reports of BaNP authorities. The study area considered for the study is one of the buffer zones of BaNP that lies in Banke district out of several other buffer zones of the park. Thus, implementing a similar survey within other buffer zones could provide a more inclusive picture on HWC, likelihood of reporting loss, and people's perception towards current compensation policy schemes.

Additionally, we did not assess any mental health status questionnaires as used by other authors to find out the specific types of PTSD symptoms which might have resulted in the insignificance of demographic variables towards likelihood to recover from trauma. The flood victims were not identified by any means of official record, and the research findings should not be considered for medical purposes. In addition, due to time constraints we were not able to consider all of the flood victims, including the ones who migrated after the flood event or were displaced. The survey data was based entirely on the verbal communication with the respondents and an interpreter who translated non-Nepali speakers' responses. Due to the categorical nature of the variables considered for this research, I believe that responses requiring translation would not limit the results observed.

While there is more that could be explored to understand HWC and recovery from extreme flooding events, this preliminary research provides an introduction for complex environmental, economic, and social problems in Nepal. This research could be expanded

to include other parts of the country, and other developing countries that experience challenges with conservation areas and/or persistent natural disasters. By doing this, pressured regions can stand to develop better policies that address the needs of vulnerable communities.

Appendices

A. Questionnaire Survey (Human-wildlife conflict)

The purpose of this study is to find some answers related on human-wildlife conflicts at your locality. This research is based on the answers of yours. You were randomly selected to participate in this study. This questionnaire will not take more than 20 minutes. Your participation in this survey is voluntary. If in any part of the questionnaire you wish to discontinue the interview, please do. Any response you give will be kept confidential and it will not be linked to you. Thank you for your cooperation and it's very much appreciated! If you are ready, should we proceed towards the questions?

Demographic factors

- 1) What is your age (in years)?
 - a) 20-29
 - b) 30-39
 - c) 40-49
 - d) 50-59
 - e) ≥ 60
- 2) Please select your gender:
 - a) Male
 - b) Female
- 3) What is your education level?
 - a) Illiterate
 - b) No formal education
 - c) $\leq 10^{\text{th}}$ grade
 - d) $> 10^{\text{th}}$ grade
- 4) Please select the range which corresponds to your annual household income.
 - a) $< \$1,160$
 - b) $\geq \$1,160$

- c) What is your status of employment?
- a) Self-employed b) Employee c) Farmer
- d) Housewife e) Others
- d) How much area of land do you have for farming?
- a) No land/working b) <0.835 acres c) ≥0.835 acres
- on others
- e) How many people, including yourself, are in your household?
- a) 1-3 b) 4-6 c) ≥7

Experience of human-wildlife conflict:

- f) Have you or your family member ever experienced a conflict with wildlife since 2010?

- a) Yes b) No

If yes, with which wildlife (select all that apply):

- a) Common Leopard b) Tiger c) Deer d) Monkey e) Wild birds
- f) Wild Boar g) Porcupine h) Bear i) Others

- g) Please check the activities that the wild animals caused on your property.

Activities	Village & District	Day/Night	Year/Month	Details of conflict (which wildlife?)
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Crop damage				
Attack on livestock				
Death of livestock				
Family member injury				
Death of family member				
Property damage				
Other(s)				

h) Did you report the loss to the concerned organization managing the protected area or forest?

- a) Yes b) No

If No, why? _____

******THANK YOU******

B. Questionnaire Survey (Emotional Trauma)

The purpose of this study is to find some answers related with flood at your locality. This research is based on the answers of yours. You were randomly selected to participate in this study. This questionnaire will not take more than 25 minutes. Your participation in this survey is voluntary. If in any part of the questionnaire you wish to discontinue the interview, please do. Any response you give will be kept confidential and it will not be linked to you. Thank you for your cooperation and it's very much appreciated! If you are ready, should we proceed towards the questions?

Demographic factors

- 1) What is your age (in years)?
 - a) 20-29
 - b) 30-39
 - c) 40-49
 - d) 50-59
 - e) ≥ 60

- 2) Please select your gender:
 - a) Male
 - b) Female

- 3) What is your education level?
 - a) Illiterate
 - b) No formal education
 - c) $\leq 10^{\text{th}}$ grade
 - d) $> 10^{\text{th}}$ grade

- 4) Please select the range which corresponds to your annual household income.

a) <\$1,160

b) ≥\$1,160

5) What is your status of employment?

a) Self-employed

b) Employee

c) Farmer

d) Housewife

e) Others

6) How much area of land do you have for farming?

a) No land/working

b) <0.835 acres

c) ≥0.835 acres

on others

Social and Economic Costs of damage/Flood impacts

7) When was the last time your home was affected by a flooding event?

a) Within the last 1 year

b) Between 1 and 2 years ago

c) More than 2 years ago but less than 5 years ago

d) More than 5 years ago but less than 10 years ago

e) More than 10 years ago

Please mention the flood year (if in memory) _____

8) Have you fully recovered from the emotional trauma of the previous flood?

a) Yes

b) No

9) How many livestock were killed? _____

10) What were the belongings you lost in the previous flood?

Family member	a) Yes	b) No
House damaged/destroyed	a) Yes	b) No
Livestock	a) Yes	b) No
Agricultural land	a) Yes	b) No
Other assets	a) Yes	b) No

******THANK YOU******