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Household Vulnerability to Flood Disasters among Tharu Community, Western Nepal

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Abstract: Monsoon floods are frequent in the Tarai region of Nepal and claim thousands of lives and substantial numbers of properties every year. Certain human activities are more affected than others in the case of the same hazard. This study analyzes vulnerability to flooding among Tharu households. Data were collected by employing household surveys, group discussions, and key informant interviews in the Thapapur Village Development Committee (VDC) of Kailali district, western Tarai, Nepal. The analysis presented in this study is based on the theory that underpins the pressure and release (PAR) and access models. The results show that Tharu people are the major inhabitants in the study area and they prefer to live within their community; many ex-bonded laborers (marginalized people) choose this location for residence. Human causalities have been reduced in recent years due to easy access to cell phones, which has facilitated effective flood warnings with suitable lead times, but agriculture production loss and other losses are still high. Agricultural land is not only an important natural asset but is also considered a financial asset due to its high price and private ownership. The study concludes that subsistence agriculture-based households with small landholding sizes and less income diversification are highly vulnerable to flooding. Improper resettlement of ex-bonded laborers and land fragmentation due to separation of family members are the most prominent factors resulting in small landholdings. The results can guide government authorities to develop proper flood management strategies for the people living in the lowlands (particularly the Tarai region) of Nepal.

Keywords: flood risk; social vulnerability; PAR approach; adaptation strategies; Tharu ethnic group

Citation: Pangali Sharma, T.P.; Zhang, J.; Khanal, N.R.; Nepal, P.; Pangali Sharma, B.P.; Nanzad, L.; Gautam, Y. Household Vulnerability to Flood Disasters among Tharu Community, Western Nepal. *Sustainability* **2022**, *14*, 12386. https://doi.org/10.3390/su141912386

Academic Editor: Andrzej Walega

Received: 16 August 2022
Accepted: 21 September 2022
Published: 29 September 2022

1. Introduction

Floods are one of the most frequent climatic disasters and are expected to increase in frequency and severity due to climate change and global warming [1]. Developing countries are disproportionately more affected by such disasters due to their highly natural resource-dependent economies and limited physical, institutional, and infrastructural bases to facilitate effective adaptation. Nepal ranks 30th among the most flood-affected countries in the world [2], with high human casualties and property loss every year [3]. Floods and landslides account for more than 35 percent of total disaster casualties in Nepal, followed by epidemics [4]. Intense monsoon rainfall (about 80 percent of the yearly total rainfall occurs between June and September) is the major triggering factor of flooding and associated loss, and the Tarai region is highly affected. Along with human casualties, floods destroy paddy crops, which are very important for agriculture-based livelihoods, especially in the Tarai region of Nepal, regarded as the granary of the country [2].

The vulnerability of a system to hazards is a function of the exposure to the hazard, and it has three components: exposure, sensitivity, and adaptive capacity [5] associated with livelihood attributes/assets [6]. Vulnerability is hazard-specific, and its study should be directed towards specific disaster prevention [7]. Leverman [8] has discussed physical vulnerability and social vulnerability: the first concept deals with the physical condition of the landscape and its impacts on humans. The second concept deals with vulnerability in terms of the political, social, and economic conditions of a society. Hence, vulnerability includes the adaptive capacity of communities to deal with the effects of risks associated with exposure [9]. Adger (1999) disaggregated social vulnerability into individual/household vulnerability and collective vulnerability. The present study focuses on household vulnerability to flood disaster.

The Tharu are an indigenous people scattered along the southern foothills of the Himalayas, with the majority of their population residing in Nepal [10]. They migrated from a southern desert-like plain called Thar; thus, they were called the Tharu [11]. They have distinct languages, cultures, customs, and lifestyles. The Tharu live in a compact social unit, which benefits them socially and economically, and they are linked to each other at least through religious and economic ties [10]. There are many groups and subgroups within the Tharu, with the Rana and Dangaura Tharu being the major inhabitants in western Nepal [12], and many of them are involved in agriculture activities.

The Tharu have been marginalized mainly in two ways. First, Tharu people took loans from landowners and, in exchange, they had to work for landowners' houses. If they did not return the loan on time, exorbitant debts were accumulated, and whole families were forced to work in landowner homes for years and generations [13]. Second, Tharu people have no records of land that they have cultivated. After the eradication of malaria (1950s), many hill people migrated to the Tarai plain and they marginalized the Tharu by registering their occupied lands under migrants' names, forcing Tharu people to work as agricultural laborers [13]. Later, they were called Kamaiya. A Kamaiya was generally given a fixed land size, house, and kitchen to support his family and sometimes a loan without interest. However, the Kamaiya had to give priority to his master's work as guided by the contract with the host family [14]. This cultivation institution, as practiced among the Tharu, is seen as the predecessor of what has been called bonded labor [14]. The Nepal government declared the emancipation of bonded laborers (Kamaiya) on 17 July 2000, and many of them live in the western Tarai region of Nepal [15], which is the most flood-affected region of Nepal.

As Nepal has been experiencing increasing losses and damage from flood disasters, many policies and plans have emphasized disaster reduction, including for earthquakes, avalanches, and glacial lake outburst floods (GLOFs) [3]. Khanal et al. (2007) discussed physical/spatial and socioeconomic vulnerability to flood disasters, with extreme dynamic landscapes, inaccessibility, and disperse human settlements and migration being considered the major causes of vulnerability [16]. They further stated that considering the physical aspect alone is not enough to address flood risk management; therefore, socioeconomic vulnerability needs to be addressed in the context of flood management in Nepal [16]. A different study concluded that the structural approach to flood management has not been effective but that embankments have greatly exacerbated flood hazards; therefore, is the authors proposed to adopt a social vulnerability approach for flood management in the Himalaya–Ganga region [17]. Devkota et al. (2013) identified 25 vulnerability indicators for flooding and tested them in two southern districts of Nepal, where frequent floods, river bank cutting, and agriculture loss were found to be major vulnerability indicators [18].

Some studies have attempted vulnerability mapping in Nepal, but their scopes are limited to presenting flood loss and damage assessments, together with presenting disaster scenarios in a particular study region [6,19]. Shrestha et al. (2004) developed a vulnerability map in the Ratu Khola basin using a multi-criteria analysis with the help of four parameters (house, built-up areas, land use, and road infrastructure) [20]. Aryal (2014) found that the lack of micro-disaster vulnerability analysis is a problem that renders disaster management

continuously ineffective in Nepal [21]. While nationwide population vulnerability [22] and social vulnerability [23] to the disasters can be analyzed, social vulnerability is geography- and context-specific [24]. A study that fails to understand the root cause of vulnerability will lead to the risk of further disasters [21]. However, no studies have focused on the root cause of household vulnerability to flooding disasters in Nepal, focusing particularly Tharu community. Hence, this study uses the pressure and release (PAR) and access model [25] to measure household vulnerability to flooding, which is a completely new approach to understanding disaster risk in Nepal. This study provides a new insights into the identification of differing household vulnerability to flood disasters, which ultimately helps flood disaster management in Nepal.

2. Vulnerability: Conceptual Consideration

During the 1990s, disaster vulnerability was defined based on the hazard dimension, while the social aspect was neglected. Later, socio-economic vulnerability came into consideration, where the PAR approach remained a popular model to understand the root cause of social vulnerability [26,27]. The PAR model was created to address questions that could not be answered using the risk of hazard (RH) approach to vulnerability studies [28]. PAR model outlines the causal factors and preconditions for disaster. The sole idea of PAR approach is that "the emphasis of PAR approach is on two opposing factors: the process generating vulnerability, and hazard in inducing disaster" [25]. It discusses the three stages of vulnerability: root cause, dynamic pressure, and unsafe conditions; are together called the progression of vulnerability [28]. The PAR approach to vulnerability studies is particularly useful where the different disaster effects are observed [29]. The model has successfully been applied to vulnerability studies [29,30]. Although the PAR model helps researchers to find the pressure and root cause of vulnerabilities, it does not explain much about the various disaster impacts. In this regard, the access model has been used in this study as a magnifier of the PAR approach.

The access to and benefits of natural resources are controlled by an underlying socio-economic system [31]. Under these systems, resources are not equally distributed among people, resulting in varying disaster effects in communities according to their control over resources, which also shapes livelihood systems [25]. Peluso (2020) defined access as the constellations of means, relations, and processes that enable various actors to derive benefits from available resources [32]. Access to livelihood assets allow the very basic conditions of living and meeting basic needs [33], as well as building a resilient livelihood [34]. A livelihood comprises capability, resources, and access—i.e., livelihood components [34]. Livelihood assets are categorized into five types: produced/physical, human, natural, social, and financial assets. In addition, livelihood capital and peoples' capabilities are interrelated, where capital paves the way for capability and vice versa [35]. The present study assesses livelihood assets to evaluate household vulnerability to flood disasters and helps to find the existing root cause of the unsafe conditions in the study area.

3. Materials and Methods

3.1. Theoretical Approach

The methodological and analytical approach applied in this study epistemologically adheres to the theory of coherence. Existing studies, mainly those in the social sciences, subscribe to two main theories of truth. Firstly, the theory of correspondence, which assumes that a proposition becomes true only when it corresponds with facts or real objects or phenomena [36]. In other words, this is the assumption that reality exists externally, independently of the observer and can be captured by systematic approaches. On the other hand, the theory of coherence emphasizes the validity of research not necessarily in regard to its correspondence to the events in the real world. It does not regard "real" to exist independently of the observer and therefore not amenable to be captured objectively. It rather assumes that a proposition can be regarded as valid if it is consistent with the comprehensive system of explaining the issue in question. In other words, under the

coherence theory, the validity of a proposition is evaluated not in terms of how much it corresponds to the real world but on its consistency with other theories and propositions, which are commonly used to explain the issue in question [37].

The significance given to the theory of coherence necessitates performing a critical examination of social context and social relations, including the researchers' positionality in determining the research outcome. In social science methodology, the researcher(s) is assumed to have two different positionalities with respect to the research theme as well as the communities in which the research is being carried out [38]. In the first positionality, the insider position, the researcher shares significant social attributes, such as race, gender, ethnicity, or nationality, with the community being researched. The outsider position, on the other hand, has social identities that are not closely associated with the researched community. The researcher's positionality is regarded as an epistemological principle determining differential access to information and knowledge, in that an insider position is regarded to have a better/deeper access to knowledge. The proponents of the outsider position, on the other hand, claim that they can maintain higher objectivity than insiders because they are not influenced by situated knowledge [38,39]. Despite the claimed dichotomy, many scholars have experienced that the insider/outsider binary is more arbitrary than real. Because people hold varying statuses in their interactions with others in different social settings, the boundary between insider and outsider positionality often blurs [39], and within this shifting positionality is the space of interaction, which is sought in order to produce data.

Although the authorship of this paper illustrates international engagement, the study on which this paper is based was designed and the data was collected by the first author, who holds an insider position in the researched community in terms of nationality. However, due to different geographical and ethnic origins, as well as the difference in the language spoken, the insider positionality also shifted to an outsider's positionality, thus necessitating assistance from local field assistants to interpret the responses of the respondents. The author lived in the local community and engaged in intensive rapport building for a total of fourteen weeks to collect data.

3.2. The Study Setting

Thapapur VDC (the smallest administrative unit of Nepal) in the district of Kailali was chosen as the study site. The southern Tarai region of Nepal is most prone to flood disasters [40]. Data shows that 129 individuals lost their lives to flooding, 133 people went missing and 36,514 households were affected by flooding in 2014 [2]. Kailali, the selected district, is located in the western Tarai region which is one of the highly flood-affected districts [16]. It is surrounded by rivers: Karnali River on its eastern side, Godawori River on the western side, Thuli Gadi River on the north, and the Mohana river on the south (Figure 1). The district is mainly covered by forest (64.8 percent), followed by agricultural land (27.8 percent) [41]. Thapapur VDC (Figure 1), had high flood-related loss in 2014, where one life was lost, twenty-five households were destroyed completely, and 1150 households were partially damaged [42]. This is mainly due to its location at the confluence of two big rivers: both the Mohana and Karnali rivers are located within a distance of about five kilometers. In addition, two local rivers, named Pathariya and Kandra, flow through the VDC and connect these two rivers in the southern part of the VDC.

The majority of people (85 percent) in the VDC are Tharu (an indigenous ethnic group), who lived in the district long before malaria eradication in the 1950s. Tharu choose the head of their community, known as Valmansa, who has the authority to command social work/activities. Similarly, we were told during fieldwork that the Valmansa holds the decision-making power to mobilize human and natural resources for community causes while the whole community adheres to such decisions including during a disaster. Since Tharu were the main bonded-laborers in Kailali and Kanchanpur districts in the past, these districts remain the core areas of this ethnic group today as they settled here after the

abolition of bonded laborers in 2000 [13]. People in the study area rely on agriculture activities for their livelihood; paddy, wheat, lentils, and sugarcane are the major agriculture products of the district. Monsoon paddy cultivation is a major agriculture practice, which is greatly affected by floods every year.

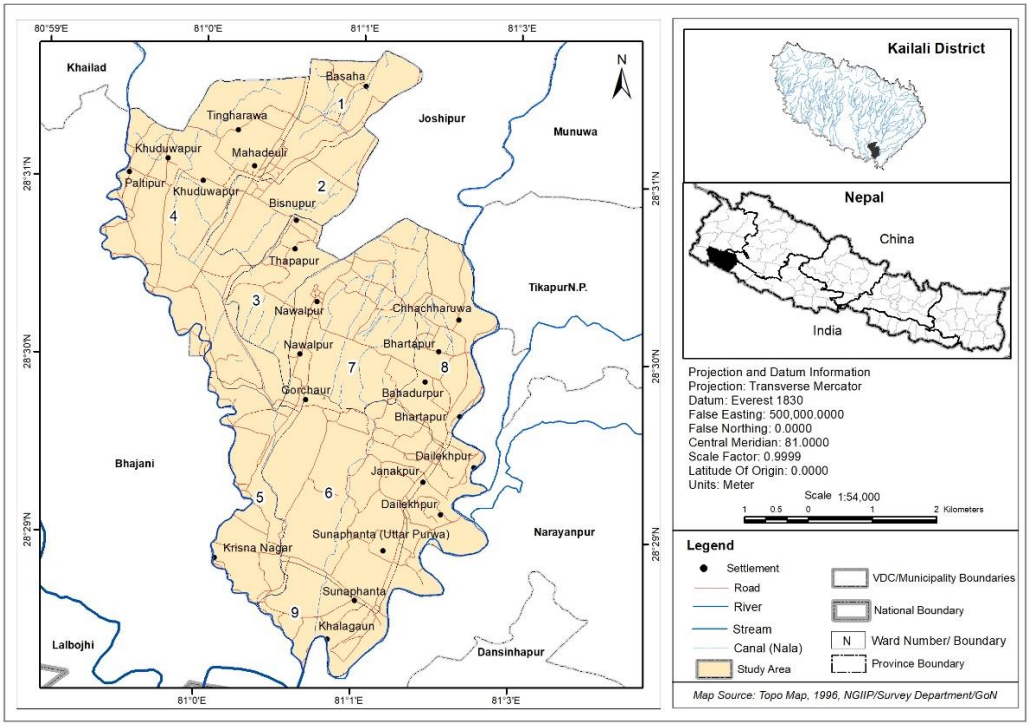

Figure 1. Location of the study area: small, medium, and large-scale rivers; neighboring districts; and the total number of settlements of the VDC.

There is no hydrometeorological station in Thapapur VDC. Therefore, the closest meteorological station to the study area is located in Dhangadhi, where the historical record shows that the area receives about 1888.1 mm annual rainfall, where 57.5 percent of total rainfall occurs in July and August (Table 1). As a result, many parts of the districts, including Thapapur VDC, are frequently affected by flooding almost every year. Moreover, human casualties from floods and landslides were high (242 person) from between 2002 to 2014. Hence, we considered 2014 for this study.

3.3. Data Collection and Analysis

Data Collection

Three different methods were used to carry out this study: household surveys, group discussions, and key-informant interviews. In addition, different government official records were also reviewed, and data were used to maintain the validity of the research. Research in human geography commonly employs qualitative research, where field observation and interviews are among the most commonly used methods to collect data in qualitative research in human geography. In much geographic research, a closed set of questionnaires is not appropriate due to unexpected scenarios that may come up during the field work, and also in many cases, it is difficult to fit an answer to the "Yes" or "No" format [43]. Therefore, a semi-structured questionnaire was used in this study, which allows the asking of follow-up questions based on informant responses.

A list of questions for household interviews, group discussions, and KIIs was prepared before the fieldwork. In the household interviews, participants were asked about their livelihood and socioeconomic conditions, flood exposure, and how floods have affected them. In this regard, they were asked to assess their vulnerability within the community.

The household survey was designed to collect information related to the demographic structure of the family, education level, income source/s, estimated annual income, production sufficiency, landholdings size, the number of livestock, flood disaster loss (in 2014), health insurance, adopted coping strategies during flooding, access to internet/mobile network, family affiliation, access to forest and market, family migration history, and the reason for choosing the existing location. In addition to that, all available livelihood assets of a particular household were listed. Additionally, building structure and building materials were assessed in terms of flood resistance.

Table 1. Meteorological conditions of the study area.

City Dhangadhi Longitude 80.6; Latitude 28.8; Elevation 187 masl			
Month	**Max Temperature (°C)**	**Min Temperature (°C)**	**Mean Precipitation (mm)**
January	20.8	7.1	28.4
February	24.8	9.3	33
March	30.4	13	16.4
April	35.9	17.6	23.6
May	37.2	22.5	78.9
Jun	36.3	25.2	252.4
July	33.1	25.7	565.9
August	32.8	25.5	520.6
September	32.4	24.2	295.7
October	31.5	18.7	51.7
November	27.8	12.4	4.2
December	23.3	8.2	17.3
Annual	**30.2**	**16.7**	**1888.1**

Source: Department of Hydrology and Meteorology, 2015.

The first group discussion with VDC representatives was carried out prior to the detailed household survey in order to collect information about flood-affected settlements/household. The second group discussion along with eight key informant interviews (KII) were carried out after the household survey. In addition, a secondary source of information was collected, comprising disaster loss data from International Centre for Integrated Mountain Development (ICIMOD), Central Bureau of Statistics (CBS) Nepal, Department of Water Induced Disaster Management (DWIDM), and District and VDC profile.

Household surveys were conducted during three-and-a-half-months of fieldwork (from 1 April to 13 July 2015). Based on the purposive (exponential non-discriminative snowball) sampling method [43], all frequently flood-affected households (99) were chosen in this study. The exponential non-discriminative snowball sampling provides multiple referrals and, in turn, each referral provides a few more until all desired units are covered (Silverman, 2004). A detailed household census of all flood-affected households in 2014 was taken.

Two group discussions were carried out. First, with VDC representatives (10 members), and second, with flood-affected households (18 members). Each discussion lasted about one hour and thirty minutes. During the group discussion, the topics of flood management practices in the VDC and external aid and its distribution and effectiveness were utilized as probe questions at the beginning, and follow up questions were then asked, where the researcher worked as a facilitator. The follow-up questions led toward flood management and difficulties at the household level and possible solutions for affected families. The follow-up questions also led to ongoing management practices and their effectiveness so far as carried out by the government and non-government organizations in the VDC. Additionally, eight key informant interviews were conducted: the VDC secretary, the chairperson of the community forest-user group, the head of the Kailali District Red

Cross, the head of the local primary school, the head of the Forum for Awareness and Youth Activity (FAYA) Nepal Kailali branch, head of Base Kailali, and the Valmansa of Wards 5 and 6 were selected as key informants. The flood management efforts of their organizations/institutions and their plan, particularly in the VDC study, were asked about during KIIs (for details please see [44]).

3.4. Data Analysis

This study uses the livelihood framework, the PAR model, and access model to analyze the collected data to assess household vulnerability to flooding. As per the essence of the PAR method of vulnerability, different types of unsafe conditions were noted during field work. Based on the PAR framework, all unsafe conditions are linked through dynamic pressure to the root cause. In other words, the root causes of household vulnerability can be traced back to existing unsafe conditions and dynamic pressures.

Composite Index*:* A settlement-wise composite flood loss index was computed using Equations (1)–(5). This index model was first used by UNDP [45] to calculate the Human Development Index; later used by Gautam and Andersen [46] to calculate household wellbeing in Humla, Nepal. Here, the index is used to calculate the cumulative disaster loss in 2014 among settlements in the study area using the following Equations (1) and (2).

$$I_a = \frac{A - A_{min}}{A_{max} - A_{min}} \quad (1)$$

where I_a is the particular disaster loss and A_{min} and A_{max} are the minimum and maximum flood disaster losses of the same category.

$$W_i = \frac{\sum_i^n I_i}{N} \quad (2)$$

where W_i is the composite disaster loss for the particular settlement, I_i is the different disaster loss index of the same settlement, and N is the number of disaster loss types. The W_i value ranges from zero to one, where the zero value represents no disaster loss, while on the other hand, value one represents a high disaster loss among the settlements.

Asset Pentagon: To assess and visualize the livelihood assets, DFID [47] first used an asset pentagon to measure livelihood asset strength into a three-dimensional view. This concept was successfully used in Nepal by Shivakoti and Shrestha [48] to assess livelihood capital for irrigation performance. In addition, many studies have been used the concept of an asset pentagon to assess vulnerability to different climate extremes [49,50]. This study adheres to the concept of livelihood assets as used in the studies, modifies their role in flood disaster response, and calculates their strength. First, all available assets of the study area were sorted into five categories and their role in flood disaster management was assessed. The assets index ranges from zero to one. The closer the index level is to one, the better the very good availability of the particular assets, whereas if the index is closer to zero, this shows poor availability of that particular livelihood asset.

$$w_a = P_a / HP_a \ldots\ldots\ldots \quad (3)$$

$$I_a = w_a * T_a \ldots\ldots\ldots \quad (4)$$

$$API_j = \sum I_a / N \ldots\ldots\ldots \quad (5)$$

where w_a is the weight of a particular livelihood asset component; P_a is the available asset condition; HP_a is the best possible role of particular assets component in flood resilience; I_a is the cumulative role of the particular livelihood asset component; T_a is the total available asset of a particular asset group (a); API_i is the asset performance index for flood resilience (i); and N is the number of components in particular livelihood assets (i) in the study area.

Details about the methodology adopted in this study is presented in the following figure (Figure 2).

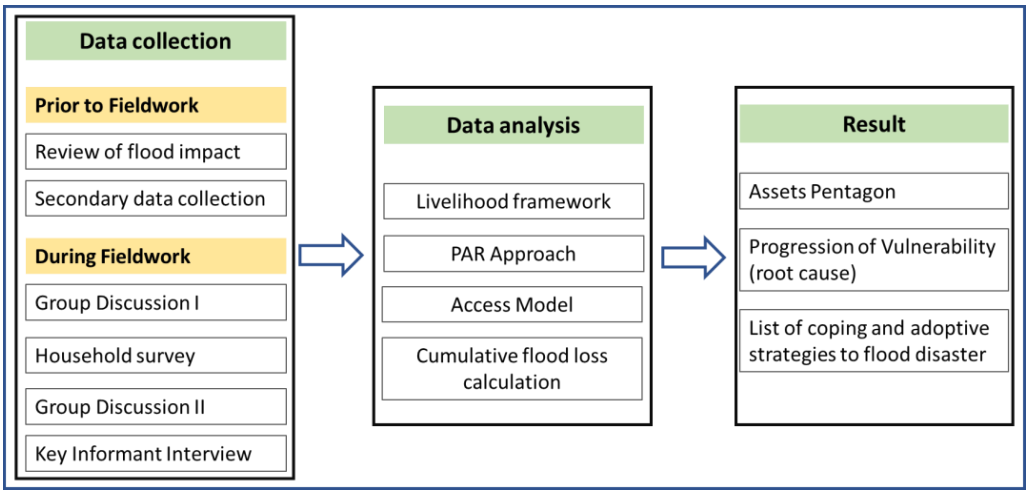

Figure 2. Methodological flowchart of the study.

4. Result and Discussion

4.1. Pattern of Flood Vulnerability

Thapapur was one of the most flood-affected VDCs of the Kailali district in 2014: forty-nine houses were partially destroyed, eleven people were injured, and 148 livestock were lost. The paddy production loss was considerably high (1767 quintal (176,700 kg)) in 2014. Details about settlement-wise flood loss, including lives lost and properties damage, are compared and presented in Table 2.

Table 2. Loss and damage of lives and properties in Thapapur VDC, 2014.

Ward	Settlements	HD	*I*	PI	*I*	LL *	*I*	EA **	*I*	W
3	Bisnapur	4	0.3	2	0.67	2	0.06	36	0.07	0.27
8	Chacharahuwoa	4	0.3	3	1	13	0.37	31	0.06	0.43
6	Gorchaura	11	1	0	0	35	1	332	0.89	0.72
9	Janakpur	1	0	0	0	9	0.26	128	0.33	0.15
5	Khaira	1	0	0	0	4	0.11	70	0.16	0.07
5	Krishna Nagar	8	0.7	1	0.33	7	0.2	371	1	0.56
2	Mahadevwoli	3	0.2	1	0.33	2	0.06	48	0.1	0.17
4	Mohanpur	4	0.3	3	1	0	0	211	0.56	0.46
7	Nawolpur	3	0.2	0	0	12	0.34	123	0.31	0.21
9	Sonaphanta	6	0.5	1	0.33	35	1	246	0.65	0.62
3	Thapapur Gaau	2	0.1	0	0	19	0.54	11	0	0.16
4	Tingharuwoa	2	0.1	0	0	10	0.29	160	0.41	0.2
	Total	49		11		148		1767		

Source: Field survey 2015. * Goat, sheep, hen, duck, and pigs; ** estimated paddy loss (in quintal). HD = House Destroyed; PI = People Injured; LL = Livestock Loss; EA = Effect on Agriculture; *I* = Index; W = Disaster Loss Weight.

The disaster loss index shows that Gorchaura settlements were highly affected (0.72), followed by Sonaphanta (0.62) and KrishnaNagar (0.56). On the other hand, the Khaira settlement was the least affected by the floods in 2014 (Table 2). Besides tangible flood losses, there are many intangible flood losses in the study area. Flooding affected daily activities, such as cooking, schooling, and shopping. Households submerged in the floods had kitchen utensils, stored firewood, and grain swept away; these are the most common flood losses observed in the VDC. However, not all households were equally affected, which means varying flood effects are seen throughout the study area, which is a major concern of this study.

4.2. Household Livelihood Assets

Livelihood comprises five types of capital, and livelihood strategies are the way in which people use these assets to make a living [51]. The access to five types of livelihood assets (human, financial, physical, natural, and social) is very important to meet sustainable livelihoods [35]. A sustainable livelihood should be able to cope with and recover from external stress, while maintaining existing capabilities and assets [34]. Proper access to all required livelihood assets is required to obtain a resilient livelihood. Thus, the following section compares the available assets to measure their strength in household livelihood.

4.2.1. Livelihood Assets

Human assets include household size, professional skill (education/training), and health insurance. Since traditional Tharu have a joint family structure, they have a very good human workforce. The majority of households (58 percent) have 5–9 family members. Tharu believe that having large family size is good for farming work. In other words, the more active the family is in terms of active labor, the more it is considered to be economically prosperous. Irrespective of age, everyone contributes to household work as well as working in the field, and a group of experienced workers decide whether an individual is capable of paid agricultural work (*Khetala*). There is an agricultural wage difference between men and women. Men get higher wages and have more job opportunities than women, so having many men in the family is considered as good for household income. On the other hand, women are mostly bound to household work. The sex ratio (111) is high, where Ward 8 has the highest sex ratio (142) in contrast Ward 2, which has the least (86) sex ratio. Education strengthens human capability, which helps sustainable livelihood [35]. However, in context of the study area, education is viewed as a future economic turnover. The majority of the people (52 percent people) completed their primary and secondary education but very few, about six percent, continued their study up to higher secondary education (+2 level) because people send their children to school so they write their name and compute daily calculations. About one-third (33 percent) of the active population do not have any formal education.

Social assets embrace the connections and networks within the community and sometimes beyond that group. In other words, they can be defined as social relationships that are gained through family networks and kin, memberships to the formal groups, reciprocity, and cooperation [47]. Social connection partly determines the future career of a family member, because the network plays a crucial role in the job market [52]. Social interactions can be categorized as formal and informal; the formal refers to individuals' involvement in the official sector, and informal social interaction denotes social relations and familial connections [52]. In the context of the study area, the informal social network is stronger than the formal one, which is facilitated through joint family structure and kin. Additionally, very few households (ten percent) have a connection/relationship with a government officer.

Natural assets: The VDC is located in the Tarai region and has many natural resources, where forest, river, and fertile land are the major natural assets. Traditional Tharu culture is closely connected with fishing, and many people utilize the river for fishing, using fishing-nets, throughout the year, irrespective of weather conditions, and fish is the usual meal for the traditional Tharu community. Besides fishing, the river is used for irrigation using a pump set. Alluvial soil deposits during floods help to increase winter production. The VDC has a community forest named *Bandevi*, established in 2000, which is used for firewood and fodder, which are very important for rural livelihood. The use of the community forest is regulated under the Community Forest Management (CFM) Nepal's terms and conditions. Moreover, fertile land is another major natural resource of the VDC; however, due to land privatization, the area has unequal land distribution.

Financial assets: There are two types of financial assets under the household livelihood system: available stocks and the regular flow of money [47]. The available stocks denotes the cash and bank deposits; on the other hand, remittance, pensions, or other

income is a regular inflow type of financial asset [35]. Agriculture is a major occupation in the study area, and about 73 percent of households depend on agriculture. Therefore, surplus agricultural production is considered an important financial asset.

Based on the yearly paddy production sufficiency for the average family size (7–9 members), a household's landholdings are categorized into three groups: small (not sufficient) landholdings (<5 Kattha (1 Kattha is equal to 0.0338 hectares)), sufficient landholdings (6 to 20 Kattha), and large landholdings (>20 Kattha). About 32 percent of households have large landholdings, whereas 26 percent of people have small landholdings (field survey, 2015). Normally, people harvest twice a year, summer and winter cultivation, but few households, especially those who have small landholdings, harvest three times per year. *Chaite Dhan* (paddy cultivation starts in May) is planted between winter and summer cultivation.

Besides farming, livestock, remittance, and daily wages are a major regular inflow of financial assets in the VDC. A number of one in ninety-nine households has a member in a government job, twelve percent rely on foreign employment (remittance), nine percent of households rely on wage labor, and three percent rely on small-scale businesses for their livelihoods. Agricultural wage labor is a very common income source, where the wage is determined by a VDC meeting in presence of the *Valmansa* at the beginning of the summer cultivation. The meeting confirm equal wages for men and women, but in practice, men get 300 NRS (about 3 USD) and women get 250 NRS (about 2.5 USD) per day (in 2015).

Physical assets: Agriculture tools/equipment, vehicles, house structures, and irrigation pumps are the major physical assets found in this area. Access to transport facilities is important in the context of rural livelihood [53]. Intensive vegetable farming can be the best option for small landholding families, but they need better access to the market, which can be facilitated through the technical and managerial improvements of available public transportation facilities [53]. Being in the Tarai region, the study area has road access, but all roads are muddy and the conditions worsen during the monsoon. Additionally, tractors and pumps are other physical assets, which are very important in extensive farming; only three households have a tractor and many, but not all, households have a pump. Those who do not have a pump have formed user groups to obtain these benefits as a group.

The use of cellphones is very crucial in the rural livelihood system, particularly in flood disaster management. The use of a cellphone helps to coordinate and disseminate information between upstream and downstream, which is highly appreciated in the study area. More than ninety percent of households have at least one cellphone and they obtain flood information on it. In addition, Dallap (a two-wheeled cart pulled by bulls) and bicycle are the most frequently used physical assets. Every household has at least one bicycle, and the majority of households have *Dallap*, which are frequently used to transport agricultural goods. Building structures are crucial in the context of flood disaster management (Thieken et al., 2007). The single story, traditional buildings of the Tharu, made of timber and mud, are highly susceptible to flooding. However, 76 percent of total households have the traditional type of *Kachi* buildings (made of wood and mud). Fourteen percent of houses are two stories and made of wood, timber, and mud, whereas nine percent of households have *Pakki* houses (made of concrete/cement).

4.2.2. Assessment of Livelihood Capitals

Based on the above-mentioned discussion and Equations (3)–(5), all available livelihood assets were measured in terms of their use in monsoon flood disaster management and presented in Figure 3 as an "assets pentagon". An asset pentagon helps to visualize the access profile to livelihood assets. The mid-point of the asset pentagon refers to zero assets, whereas datapoints on the outer perimeter (close to one) represent very good access to assets [47]. This method is mostly used to visualize strong and weak livelihood assets. Figure 3 shows the condition of the present status of the overall livelihood asset conditions in the study area; this helps to understand strong and weak assets. In other words, it is easy to visualize weak assets to understand household vulnerability.

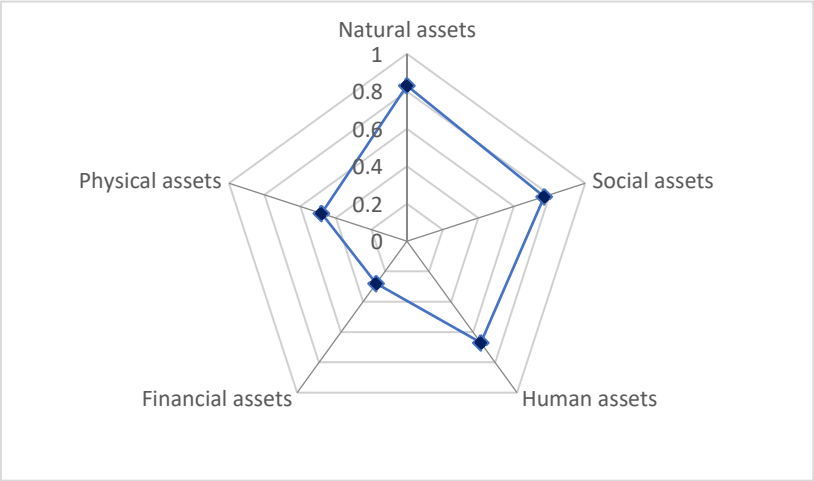

Figure 3. Assets pentagon of the affected households. *Source: Field survey 2015.*

The figure shows that access to natural and social assets is very good in the study area. A strong community bond is extant, which is governed by *Valmansa* and good informal social networks are also present. In contrast, financial assets are weak, and as a result, many households are obliged to live in the frequently disaster-affected area, even though they know that the place where they have been living is unsafe in regard to flooding.

4.2.3. Livelihood Strategies

In the beginning, slash and burn agriculture was highly practiced by *Tharus* until the Nepal government banned clearing forests in the 1980s [54,55]. At present, irrespective of landholding size, almost all Tharu households rely on farming activities. Although some households do not have enough land, they practice sharecropping-type farming activities. Sharecropping is commonly practiced in this region, where landowners let others work in their field/land, and in return, they receive half of the total yearly production.

The availability of work is highly shaped by the existing occupation of the family; although the financial condition, education level, and social networks of the family play an important role (Fieldwork, 2015). In addition, in most cases, income diversification is found in rural livelihoods [53]. Nine households have a single source of income, 58 households out of 99 households have two income sources and the rest of the households (32) have three or more sources of income. Besides all income activities, paddy production is very important in the area, and sixty percent of households fully rely on crop production. The number of individuals dependent on farming was high in the past. Five years ago, farming was a major income source for 69 percent of households, but it has declined to 58 percent in 2015 (Figure 4). If we see the five-year difference, dependency on crop production and wage labor has decreased, and dependency on the employment sector (foreign, private, and government) has increased (Figure 4).

Income diversification is more common in rural livelihood systems [53], the most common household strategies in the study area are presented as follows: a single family with small landholdings, harvesting twice in a year, has some livestock (goat and cows), feeds agriculture residue to livestock, and uses animal dung as fertilizer in agriculture. In addition, they do shared-crop farming practices to fulfill the yearly food demand of the family. Some people go to Dhangadhi (district headquarters) as wage laborers during their spare time (mainly between winter and summer cultivation). Additionally, individuals do the agricultural wage laborers during the farming season. Having livestock, they engage themselves during their leisure time and they make money by selling livestock when there is an emergency.

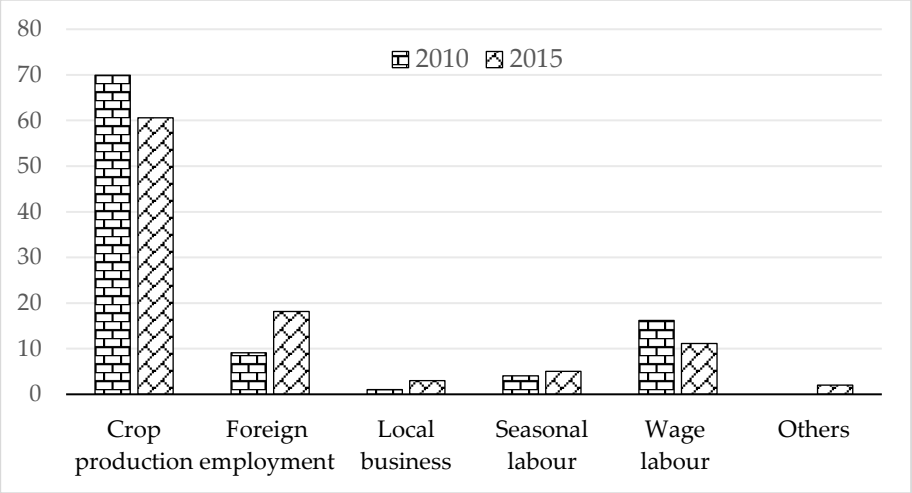

Figure 4. Changes in household income sources over the last five years.

4.3. Unsafe Conditions

The PAR approach helps to identify certain root causes that create unsafe conditions through a progression of vulnerability. To understand the root cause of unsafe conditions, we first need to understand existing unsafe conditions and trace them back to dynamic pressure and the root cause. From the fieldwork, it became apparent that flood loss varies among households and all flood-affected families know that their housing location is not safe, even though they have been living in the same location for years. It indicates that there are underlying causes that force them to live in such unsafe conditions. Based on the available livelihood assets and total disaster loss data collected during fieldwork, we found two major causes that push households to live in such conditions, which are discussed in the following section.

4.3.1. Improper Resettlement Scheme for Ex-Bonded Laborers

Twenty-four out of ninety-nine households are of ex-bonded laborers, and their housing location is at higher risk than in old settlements. In 1998, the government of Nepal decided to free bonded laborers (for details see [13]). Since then, many bonded laborers have been freed without proper government support, and ex-bonded laborers did not receive a proper allocation of livelihood assets. The government support was not sufficient to start a new life, and as a result, many of them were compelled to live in this location. During rehabilitation, ex-bonded laborers received three *Kattha* of land, and while it was not suitable for housing, they had no option of settling elsewhere. Since many ex-bonded laborers were Tharu, many of them choose to resettled in the Kailali and Kanchanpur districts, where the majority of the inhabitants are Tharu. The reason behind the choice of their current location of residence, a respondent said "*aafno manxe vayeko thau ma sukha dukkha ma saath painxa*", which means they believe will receive help when they most need it from the same ethnic group to which they belong.

During the fieldwork, it was observed that old settlements are less affected by the flooding, whereas the new household are being settling in the lowland. The ex-bonded laborers have good experience of working in the fields, but when they were freed, they did not receive sufficient land for farming. Therefore, they have limited options for maintaining a livelihood because capability plays a crucial role in shaping livelihoods [35]. All ex-bonded laborers depend on wage labor as an income source for their livelihoods and some have practiced the share-cropping type of agriculture practice. A participant (ex-bonded laborer) told us that they had a better life before than they do now; now they are free to make decisions but poor access to assets has forced them to live in unsafe conditions.

4.3.2. Fragmentation of Land

Traditional Tharu families used to have a joint family structure, which promoted income diversification and was more resilient than the single income-based household. However, the new generation prefers to live separately from their parents. They claim parental property rights, including land. The separated family needs to establish a new livelihood system independently; in this process, those who do not have enough land or are entitled to less land are forced to settle in unsafe locations. Moreover, landholding plays a crucial role in an agriculture-based livelihood system. A family with a large landholding yields surplus production and even if the flood affects their summer cultivation, they pose the potential to have a good winter production and recover the flood loss. Having surplus production, they receive a good income and have the capacity to build a flood-resistant house. Additionally, the household head has a good social position, which further strengthens their social assets. On the other hand, a household with a small landholding with no surplus production go for wage labor or took loans for their survival remains more vulnerable to flood.

The household vulnerability to flood disasters is discussed based on the PAR model (Winser et al., 2004) and presented in Figure 5, which connects root cause, dynamic pressure, and unsafe conditions as a holistic way to understand household vulnerability to flood disasters. Figure 5 points out three major root causes: poor resettlement schemes for ex-bonded laborers, population growth, and the unequal ownership of land, which create dynamic pressures that generate unsafe conditions. The limited livelihood opportunities, land privatization, the poor management of ex-bonded laborers, subsistence agriculture, illiteracy, weak social protection measures, and inadequate alternative livelihood opportunities are major dynamic pressures in the study area. As a result, many houses are built in flood-prone area, wood and mud are used to build a house, not enough self-protection measures are taken, no capital stock is extant, families have no life insurance, and areas have poor physical infrastructure (Figure 5).

4.3.3. Poor Access: The Reason for the Unsafe Conditions

The access model deals with the reason why some people are more vulnerable than others while facing the same hazards [25], it talks about access to livelihood capital as well as dealing with self-protection, social protection, and the structure of domination, thus it is different from the livelihood framework. Since household livelihood capitals have been discussed in the previous section, here we deal rest of the components of the access model.

The structure of domination shows the community connection with the state and government. In the study area, a structure of domination can be achieved if someone from the community belongs to any national political parties or high-profile government posts. However, nobody from the study area has such a structure of domination. Social protection means policies and programs prepared by the government to help their people in difficult situations. It also includes efficient labor markets and enhancing livelihood capacity to save lives during times of crisis [56]. A proper flood disaster preparedness plan and rescue/rehabilitation effort from government institutions would be the best example of social protection but such activities are hardly seen in the study area. However, some NGOs and INGOs (refer to Section 3.4) are working in disaster awareness and management in the study area.

Access to health facilities, information, income opportunity, and so on are crucial in a sustainable livelihood system. To control post-flood loss, access to health services is important in flood-affected areas. However, in the study region, the local health clinic is closed during the monsoon season, and there are no plans for developing health institutions within the VDC; thus, residents need to go to the nearest municipality, Tikapur or Dhangadhi, for simple medical treatment. Meanwhile, the muddy roads worsen and are difficult to travel during the monsoon season in the study area, which makes it more difficult access such facilities.

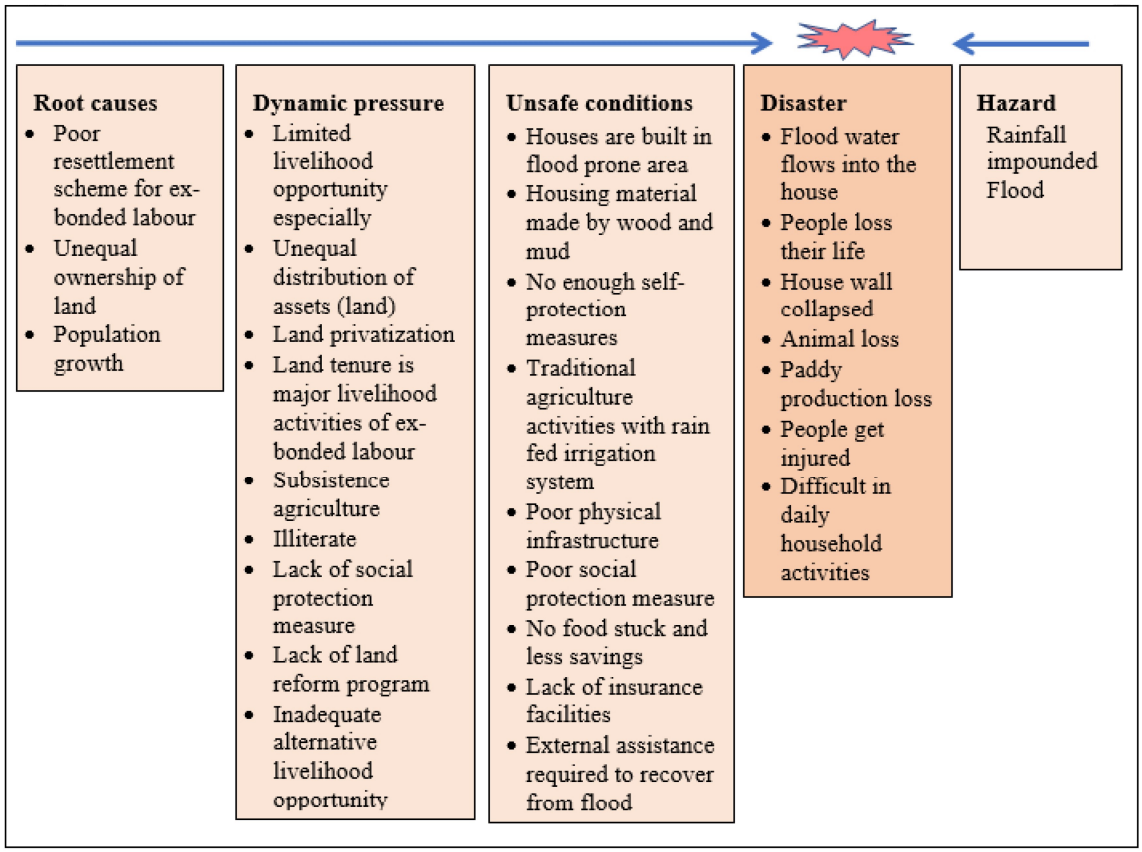

Figure 5. Progression of vulnerability.

4.4. Coping and Adaptation Strategies

As Smith [57] mentioned, coping and adaptation strategies are highly varied based on their existing economic status, the availability of agricultural land, and dependency ratio in the study area. In addition, post-disaster reconstruction activities are crucial to facilitate coping and adaptive strategies [58,59]. The local NGOs, Mercy Crop, Red Cross, Forum for Awareness and Yuth Activity(FAYA), Conscious Society for Social Development (CSSD), and Base Kailali, are working on different coping and adaptation strategies. They provide periodic training for affected families to deal with flood: before, during, and after a disaster. They provide instruments that are useful during flooding: life jackets, torches, whistles, and so on. As *Valmansa* holds the local-level decision-making power to mobilize human and natural resources, the *Valmansa* also urges villagers to help affected people in their communities, which mainly becomes benificials to post-disaster recovery. In addition, locals have different user groups to support their people, FAYA helps to form such user groups, and all members collect grain and sell the collected grain to get cash; FAYA then double the money earned, make a fixed deposit in the bank, and use its interest for disaster management during crisis time. In addition, CSSD has made small farmer groups to help farmers financially to raise livestock.

Many people in the study area can swim very well because they grow up playing in the river. Some skilled swimmers of the VDC collect timber and wood from flooded water and make good money by selling them. Women are less skilled in swimming than many men due to social restrictions: women are supposed to cover their whole body while swimming and are not allowed to swim together with men. In addition to that, women do not have time to learn swimming because they spend most of their time on housework but the study shows that women are highly exposed to floods than the men.

The river-bed shifting is another major problem in the VDC, where large landmasses are being swept away by the river every year. The Lutheran World Federation had fi-

nancially supported planting Napier grass to protect settlements from direct floodwater flow into the settlement. Residents constructed a fence of wood around their houses as protection and refilled soil in their yards to reduce water accumulation after the flood event. Some locals are informed about possible floods based on the rainfall intensity at the river upstream by their relatives using a cellphone. Later they disseminate the information by using a cellphone or using a horn in a possible flooded area, which is a highly common method in disaster early warning systems [60]. When a family receives information about a possible flood, they move their children, livestock, and important documents to a safe location, particularly to their relatives' houses and at least one family member stays at the home to take care of the property.

Every year all households set plans for possible future floods before monsoon season. Their plans mainly focus on repairing and rearranging flood rescue materials and the collection of funds. The household head returns to their home during the monsoon season from their seasonal work mainly for two reasons: for paddy cultivation and saving properties from the floods. People buy first aid kits before the monsoon period starts. Twenty-seven percent of households keep first aid kits in their home. Insurance skim could be a good option for post flood recovery, especially for the residents of the frequently disaster-affected regions [61]; however, only 12 percent of households are currently enrolled with life insurance companies.

Since Tharu have lived in the same area for a long time, they have learned many adaptation strategies. The single-story traditional house structure has been changed into two-storied houses. Residents keep grain on the second floor, called *Thati*, which used to be kept the ground floor. The building materials of the old Tharu house have changed to Saal (Shorea robusta) wood and concrete, which is much resilient in terms of flooding. They store food (garlic, onions) by suspending them from the ceiling. Modern water taps are placed high up inside buildings to allow access to clean water during flooding.

As Ellis [53] described, livelihood diversification can be the good way to reduce disaster impact and maintain a sustainable livelihood, especially in frequently disaster-affected areas. Though many households rely on agriculture for their livelihood, they have other income sources as well, i.e., seasonal work, wage labor, livestock, and so on (Figure 6). Similar cases have been found by [46], who have discussed the effectiveness of income diversification to cope with external stress and strengthen household livelihood systems.

Strong human and social assets play a crucial role for all households to cope with flood disasters every year. Building structure changes, refilling soil around the building every year before the monsoon season, food storage mechanisms, high raised goat-sheds and tube-wells, threefold cultivation practices, learning swimming, and income diversification are observed adaptation strategies in the study area. Good community coordination during flooding, the provision of economic support from different user groups, and moving their livestock to a safe area after a flood warning were observed coping strategies in the study area.

Normally, locals harvest two times a year in Nepal. However, some households have started harvesting three times in a year to minimize dependency on the summer cultivation, which is prone to monsoon flooding. Local people have introduced *Chaite Dhan* (paddy cultivation starts in March) in the study area. However, not all households have been practicing *Chite Dhan* because it is costly and needs frequent irrigation, unlike summer paddy cultivation. The adaptation practices observed (mostly learned from previous flood events) in the field are listed in Table 3. Although flood events left negative effects on household livelihoods, residents have also been taking advantage of floods, especially Tharu. They believe flooded water brings fish to a ditch near to their house and pours fertile soil into the agriculture fields. In addition, local people collect fuelwood that the flood brings. In this way, the local people have developed adaptation strategies to cope with frequent floods; they invested their time and energy to restore the flood-affected, human-built environment.

Figure 6. Sources of income. *Source: Fieldwork 2015.*

Table 3. Observed coping and adaptation strategies.

Strategies	Nature of Coping	Activities
Pre-disaster activities	Blocking	Dam construction along the Kandra River Napier plantation along the river Short Gabion construction
	Avoiding	Soil filling in the yard and around the house Small dam construction around the house Distribution of mosquito nets
	Awareness	Awareness program by local NGOs Search and rescue training Water purification training
Impact minimizing strategies	Before the flood	Keep more cots (Khatiya) in house Food suspended from the ceiling Important documents are kept in a safe place Dry food management and storage
	During the flood	Move things to Thati (second story) or onto cots Overturn cot and sit on it Keep everything at safe heights Send family members to safe areas/buildings Stay upstairs and see what can be saved
Post-event coping strategies	External relief	Essential materials provision by Red Cross Spread information to the responsible body Provision of Timber CFG to build a tall house Rehabilitate affected people
	Household action	Lend to villagers Reconstruction of house walls Search for seasonal work
Change in livelihood as an adaptation process	Structural change	New houses are tall and have two stories Use of concrete up to flooding level New roads are highly elevated Construction of high-raised livestock sheds
	Livelihood diversification	All households have livestock as part of agriculture Households have more than one income source
	Change in agriculture patterns	Early plantation Cultivating *Chaite Dhan*

Source: Field survey 2015.

5. Conclusions

The study concludes that improper government resettlement schemes for ex-bonded laborers and population growth-lead land fragmentation are the major root causes of unsafe conditions in the study area. A household with small landholdings (especially ex-bonded laborers and newly separated households) are prone to flood disasters. Ex-bonded laborers have used inappropriate land for housing (especially lowland) with limited livelihood assets. In addition, newly separated families also settled in the *Khet* (low land), which cause high flood loss. Uneven land distribution is another major cause of differentiated flood impacts, where old settlements are less affected by flooding. Joint family structures are mainly observed in agriculture-based household and that allow strong human capital, income diversification, and help with responses to flood disasters. Moreover, Tharu have strong community bonds, guided by *Valmansa*, which are mainly helpful during flooding and rescue operations. In this way, informal social networks (social assets) are strong among Tharu, whereas formal networks (networks with high officers or politicians in high posts) are weak.

This study highlights the root cause of frequent flood disaster in one of the highly flood-affected regions of Nepal. The research findings could guide responsible government authorities to develop proper flood management strategies by providing access to fundamental household livelihood assets. This study fails cover the entirety country and has particularly focused on the western Tarai region of Nepal, which is the main limitation of this study. Interested researchers are encouraged to conduct similar research in the comparable geographic region.

Author Contributions: Conceptualization, T.P.P.S., N.R.K. and P.N.; methodology, T.P.P.S., B.P.P.S. and N.R.K.; validation, T.P.P.S., L.N. and Y.G.; formal analysis, T.P.P.S. and P.N.; investigation, T.P.P.S.; resources, J.Z.; data curation, B.P.P.S.; writing—original draft preparation, T.P.P.S. and Y.G.; writing—review and editing, J.Z., N.R.K. and P.N.; visualization, B.P.P.S. and L.N.; project administration, J.Z. and B.P.P.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Strategic Priority Research Program of the Chinese Academy of Science-A (No. XDA19030402), the National Natural Science Foundation of China (Grant Nos. 41901342, 31671585), "Taishan Scholar" Project of Shandong Province and Key Basic Research Project of Shandong Natural Science Foundation of China (Grant No. ZR2017ZB0422).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Authors would like to acknowledge Chinese Academy of Sciences, National Natural Science Foundation of China, and Shandong Natural Science Foundation of China. In addition, the first author would like to acknowledge Lånekassen (Norwegian Education Loan Fund) for providing M.Phil. scholarship at the University of Bergen, Norway. First author, would also like to remember late Tor Halfdan Aase for his guidance during M.Phil. research.

Conflicts of Interest: The authors declare no conflict of interest.

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