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Women's engagement in flood hazard adaptation
in Nepal

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Climate Change Management

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I confirm that the work is self-prepared and that references/source references to all sources used in the work are provided, cf. Regulation relating to academic studies and examinations at the Western Norway University of Applied Sciences (HVL), § 12-1.

Abstract

This study presents an in-depth analysis of women's engagement in flood hazard adaptations in Arnuwa village, one of the frequently flood-affected areas of the lower Karnali river basin in Nepal. In specific, it examines the socio-cultural status of women who are at risk of flood, their engagement in adaptation actions, and the relations between the socio-cultural status and the engagement in adaptation actions.

An individual questionnaire survey with the female members from the flood-affected households was carried out to explore the socio-cultural status and the engagement in adaptation actions. In addition, four key informant interviews and a group discussion were conducted to further get into the local context and the reasons behind the adaptation actions and, also to explore the relations between socio-cultural aspects and the adaptation actions. Descriptive statistics were applied to analyze the numerical data. The answers from key informant interviews and group discussions were transcribed and used to further explain the findings and to justify the reasons behind the relations between the variables like the socio-cultural status of women and their engagement in adaptation actions.

The result related to the socio-cultural status of women in Arnuwa shows that the people in the village belong to the three different castes – *Hill Brahmin/Chhetri*, *Terai Janajati*, and *Terai Dalit*. The education level of the women is quite low as many of the women are illiterate. Around half of the respondents were household heads.

The respondents have experienced at least two floods in the last ten years. The major effects of the floods were the loss of crops in the field, damage to the houses, and loss of food items inside the house. The early warning system had encouraged them to take adaptation actions and the siren is the main one. The women have engaged themselves at least in two types of adaptation actions related to flood hazards.

Caste is one of the main socio-cultural aspects of the study area shaping the engagement of women in flood hazard adaptation practices. In the caste-wise engagement analysis, there are differences between the *Terai Janajatis* and the other two castes (*Hill Brahmin/Chhetri* and *Terai Dalits*). In the five categories of adaptation actions, *Terai Janajatis* has the highest level

of engagement in physical, ecosystem-based, social, and institutional adaptation actions followed by *Hill Brahmin/Chhetri Dalit* on average has the lowest level of engagement in many adaptation actions. Out of a total of twenty adaptation practices, Terai Janajatis have a higher level of engagement in fourteen actions. Likewise, the women with upper education levels were found with a higher level of engagement i.e., twelve adaptation practices out of a total of twenty. Similarly, the women who are leading the household were found leading their engagement in thirteen adaptation actions.

Acknowledgment

I am very much indebted to the Western Norway University of Applied Science for granting me an opportunity to study climate change management, a most awaited area of study by me. I would like to give sincere thanks to my supervisors Marte Lange Vik and Siv Helen Strømmland for their valuable suggestions during the design of this study and the preliminary draft preparation. I heartily appreciate the support, suggestions, and encouragement from Rune Njøs, the supervisor during the finalization of the thesis without whom, it would not be possible to submit the work on time.

I don't have any words to express my feeling to my mother, who has always been the backbone of my study career. My two children and husband who have the courage to stay without my physical presence always inspired me to complete the task on time.

I cannot forget the help from the women from Arnuwa village, who responded to my questions sincerely despite being busy with their regular tasks. Finally, I would like to express my thanks to all those who helped me before and during this study.

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Contents

Abstract.....	i
Acknowledgment.....	iii
Contents.....	iv
List of Tables.....	vi
List of Photos.....	vii
List of Map.....	vii
List of Figures.....	viii
1. Introduction.....	1
1.1 Background of the research.....	1
1.2 Research questions.....	3
1.3 Structure of the study.....	3
1.4 Limitations of the study.....	3
2. Literature review.....	5
2.1 The citizen’s engagement in climate change adaptation actions.....	5
2.2 Gender roles in the citizen’s engagement.....	5
2.3 Socio-cultural aspects in the gender roles.....	7
3. Methodology.....	9
3.1 Study area selection.....	9
3.2 Data collection.....	11
3.3 Data management and analysis.....	12
3.4 Research design framework.....	13
4. Results.....	14
4.1 Socio-cultural status of women.....	14
4.1.1 Caste.....	15
4.1.2 Education.....	16

4.1.3	Household head.....	16
4.2	Women’s experience of the floods.....	17
4.2.1	Loss and damages of properties due to floods.....	17
4.2.2	Women’s experience in receiving flood messages.....	18
4.3	Women’s engagement in flood hazard adaptation actions.....	20
4.3.1	Women’s engagement in physical adaptation actions.....	21
4.3.2	Women’s engagement in ecosystem-based adaptation actions.....	22
4.3.3	Women’s engagement in social adaptation actions.....	22
4.3.4	Women’s engagement in institutional adaptation actions.....	23
4.3.5	Women’s engagement in other adaptation actions.....	24
4.4	Relations between socio-cultural aspects of the women and their engagement in flood hazard adaptations.....	27
4.4.1	Castes and the women’s engagement in flood hazard adaptation practices.....	27
4.4.2	Educational status and the women’s engagement in flood hazard adaptation practices.....	31
4.4.3	Status as a household head and women’s engagement in flood hazard adaptation practices.....	32
5.	Discussion.....	34
6.	Conclusion.....	37
	References.....	38
	Annexes.....	41
	Annex 1 : Notification from NSD about the approval.....	41
	Annex 2: Individual Survey Questionnaire.....	42
	Annex 3: Key Informant Interview and Focus Group Discussion checklist.....	48

List of Tables

Table 1: Percentage of women within caste who had engaged themselves in different flood hazard adaptation practices	27
Table 2: Percentage of women within educational status who had engaged themselves in different flood hazard adaptation practices	31
Table 3: Percentage of women within the status of household head who had engaged themselves in different flood hazard adaptation practices	32

List of Photos

Photo 1: Arnuwa village flooded by October 2021 flood.....	10
Photo 2: People moving out to the safe place during October 2021 flood.....	26

List of Map

Map 1 Arnuwa village, the study area.....	10
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List of Figures

Figure 1: Research design framework	13
Figure 2: Distribution of age of the respondents	14
Figure 3: Caste of the respondents	15
Figure 4: Education status of the respondent	16
Figure 5: Loss/damages due to floods	18
Figure 6: Messaging about the floods.	19
Figure 7: Women's engagement in adaptation actions	20
Figure 8: Women's engagement in physical adaptation actions.....	22
Figure 9: Women's engagement in social adaptation actions.....	23
Figure 10: Women's engagement in institutional adaptation actions.....	24
Figure 11: Women's engagement in other adaptation actions.....	25

1. Introduction

In recent years, the impact of climate change on the lives of people and their properties is increasing. The increased risks of climate change have motivated people to explore the different adaptation options and engage in them. The types of adaptation, engagement, and the processes differ according to the type of risks and their perception by people, and the socio-cultural and economic status that the people live in, for example, gender, caste, culture, education, economy, and so on. This study explores the socio-cultural status of at-risk women related to flood hazards, the engagement of women in the flood hazard adaptation actions, and the relationships between the socio-cultural status and the adaptation practices in Arnuwa village, one of the frequently flood-affected areas, of the lower Karnali river basin in Nepal.

1.1 Background of the research

Climate change adaptation is defined as the process of adjustment to reduce the observed or anticipated adverse climatic effects (IPCC, 2007). Climate change adaptation practices around the globe vary according to the types of climate-related stresses that citizens are facing in their daily life (Adger, et al., 2007). Regarding the climate change adaptation studies, some of the core concepts have been vulnerability, resilience, and adaptive capacity. New priorities such as gender have emerged only recently (Naulu & Verrall, 2021). Here, the gender perspective allows space to analyze vulnerability, resiliency, and adaptive capacity from more than one angle.

Even though many of the recent studies related to climate change adaptation have included gender perspective, it has been mostly limited to the male-female dichotomy whereas the gender roles of a male and female are knotted into the complexities of intrahousehold dynamics as well as wider social relations (Daoud, 2021). According to the social role theory by Eagley and Wood (2012), the sex differences and similarities in the social behavior of men and women primarily come from the formation of gender roles within society.

It is widely recognized that climate change affects people differently due to the socio-cultural environment, gender norms, responsibilities, and status which result in varied climate change adaptation strategies (Ahmed and Kiester, 2021, Gracia et al., 2020). The socio-cultural

environment consists of the social system and culture of the people like social institutions, class structures, beliefs, values, accepted patterns of behavior, customs of the people, and their expectations (Kunwar, 2021). The division of gender roles between men and women guided by the socio-cultural environment has the impact that women differently engage in climate adaptation practices.

In some of the parts of the world for example Africa and Asia, socio-cultural norms and beliefs have been deeply established for centuries (Idang, 2015; UNEP 2011). These norms and beliefs have been creating a socio-cultural environment that defines the role of males and females within households and society. The studies from Burkina Faso (Nielsen & Reenberg, 2010), and Ghana (Gracia et al., 2020; Bessah, et al., 2021) in Africa as well as from Pakistan (Ashmad et al., 2021), Bangladesh (Ahmed & Kiester, 2021), Nepal (UNEP, 2011) in South Asia show limited participation of women in climate change adaptation mainly due to the influences of socio-cultural environment.

Because of the dependency and interconnectedness in society, there is the importance of gender in climate adaptation studies in the country like Nepal (Onta and Resurreccion, 2011). Moreover, the intersectional aspects like ethnicity, caste, age, wealth, class, and capabilities also play a vital role while analyzing the climate change adaptation from a gender perspective (Goodrich, Udas, & Spencer, 2019).

In Nepal, the frequency of climate-related extreme events like intense precipitation is increasing and more water-related hazards are likely in the future (MoFE, 2019). The local government which is mandated for disaster management at the local level has limited capacity (OPM, 2020). The diverse caste and ethnic groups with distinctive cultures in Nepal have an impact on diverse participation in various sectors (Pradhan & Shrestha, 2005). Despite the number of studies on flood hazards in Nepal, risk perception and citizens' engagement in adaptation from gender and caste perspective seem missing (Shrestha et. al. (2020). Whether the socio-cultural status has any impact on the participation of women in flood hazard adaptation practices or not? could be crucial in getting into the reality of citizens' engagement.

1.2 Research questions

In order to achieve the answers to the main research question outlined above, the thesis aims to find out the answers to the following three specific research questions.

- i. What is the socio-cultural status of women in Arnuwa village?
- ii. What are the flood hazard adaptation practices that the women engage with?
- iii. Are there any relationships between the socio-cultural status of women and the flood hazard adaptation practices?

To fulfill the objective, the study geographically focuses on one of the most frequent floods affected areas, Arnuwa village, in the lower Karnali river basin in western Nepal. The individual survey has been conducted with the adult female members of the households which have experienced the floods in the last ten years. The houses were randomly sampled out of the total flood-affected houses. In addition, some key informant interviews and a focus group discussion were conducted in order to get into the reasons behind the particular adaptation practices by women. Descriptive tables were generated to analyze the data numerical data whereas the texts were transcribed and presented in regard to the qualitative data.

1.3 Structure of the study

The study report has been divided into six different sections. The first section includes the introduction of the study with objectives. The second section explores the theoretical perspective related to climate change and the citizen's engagement in adaptation, the role of gender in climate change adaptation practices, and the importance of socio-cultural aspects in climate change adaptation studies. The third chapter includes the methods of the study in detail. The fourth section describes the results of the study. The fifth part discusses the findings. And the last part is the conclusion of the study.

1.4 Limitations of the study

Even though the data from Tikapur municipality shows multiple hazards in the area (Tikapur Municipality, 2018), the study only focuses on flood hazards because it was found more frequently to have greater impacts on the community. Due to limited time and resources, only one small village was taken as a study site which may not represent the lower Karnali river

basin area as a whole in terms of a socio-cultural point of view. Regarding the social-cultural aspects, this study only focuses on caste, education, and the status of women as household heads.

2. Literature review

The literature review provides the context for this study. The first part explores the climate change issues globally and in Nepal and the engagement of citizens in adaptation actions. The second part reviews the differentiated role of different gender in climate change and particularly flood hazard adaptation practices. The last part explores the theories behind the influence of socio-cultural aspects within the gender regarding the engagement in climate change adaptation actions.

2.1 The citizen's engagement in climate change adaptation actions

Climate change adaptation is defined as the process of adjustment to reduce the observed or anticipated adverse climatic effects (IPCC, 2007). Climate change adaptation practices around the globe vary according to the types of climate-related stresses that citizens are facing in their daily life. In the case of drought, the most impactful climate change effect on the livelihoods of citizens, is expanded use of traditional rainwater harvesting, shift to drought-resistant crops, rotation method of irrigation, construction of water impounding basins, use of shallow tube wells, adoption of water-conserving techniques are a few examples. Similarly, building windbreaks to improve the resilience of rangelands, monitoring the number of grazing animals, adjustment of crop schedules to suit climate variations, constructing fire lines, and controlled burning are some of the adaptation practices related to other climate stresses. Likewise, in the case of too much water and floods, construction of embankments, shift to flood-resistant crops, soil conservation measures, and migration are some of the common examples. (Adger, et al., 2007). In the present day, in the climate change and the extreme climate events contexts, climate change adaptation is an important aspect of human life, and the engagement of the citizens is becoming more crucial, particularly in the areas where the capacity of local government is limited (Adger et al., 2013; Hegger et al., 2017; Brink and Wamsler, 2019).

2.2 Gender roles in the citizen's engagement

Regarding the citizen's engagement in climate change adaptation, gender plays an important role as it shapes the male and female's division of labor, decision-making power, and opportunities within households and the community (Ravera et al., 2016; Eaglay and Wood,

2012). Oxford dictionary defines gender as *“either of the two sexes (male and female), especially when considered with reference to social and cultural differences rather than biological ones.”*

In the climate change adaptation studies, while some of the core concepts have been vulnerability, resilience, and adaptative capacity, new priorities such as gender have emerged only recently and many of the recent studies related to climate change adaptation have considered gender as one of the keywords (Naulu & Verrall, 2021). According to the social role theory by Eagley and Wood (2012), the sex differences and similarities in the social behavior of men and women primarily come from the formation of gender roles within society. Many of the roles of men and women have been defined entirely from a patriarchal perspective. The patriarchal perspective has limited the role of women in many cases regarding their daily life. Some of the common gender roles limited to the women are cooking, water fetching, other household-level chores, works related to cattle rearing, and farming. Whereas the male’s role has been mostly aligned with the economic activities like service, business, and other earning activities which are outside of the home in most cases. The major decision-making activities are also controlled by the males.

The gender lens helps the researchers to put them in a position to explore not only the aspects and extends related to women’s vulnerability to climate change but also to the extent which women can be critical agents for climate change mitigation and adaptation and reduction of disaster risk (Lewis, 2016). As many aspects of social life are gendered, it is essential to give proper attention to put the gendered lens to get into the complexities of society (Yulia, 2010). Gender also influences the decision to be included climate adaptation as it is linked with the household and community power dynamics (Ravera et al., 2016). The differentiated rights and responsibilities between male and female lead to unequal opportunities and mobility which shall further push one group to vulnerability and limits their capacity to adapt to climate impacts (Josephine, Sara, & Anne, 2019).

There are also instances that women also have active roles and engagement regarding climate change adaptation activities. The study from Laddakh, Pakistan shows that, even though men and women experience climate variability and disasters differently and women are the most vulnerable groups to climate extreme events, they are actively taking part in climate adaptation-

related works within their community and playing a positive influencer role (Datey et al., 2021).

2.3 Socio-cultural aspects in the gender roles

Gender is knotted into the complexities of intrahousehold dynamics as well as into the wider social relations (Daoud, 2021). It is widely recognized that climate change affects people differently due to the socio-cultural environment, gender norms, responsibilities, and status which result in varied climate change adaptation strategies (Ahmed and Kiester, 2021, Gracia et al., 2020). The socio-cultural environment consists of the social system and culture of the people like social institutions, class structures, beliefs, values, accepted patterns of behavior, customs of the people, and their expectations (Kunwar, 2021). In some the regions for example Africa and Asia, socio-cultural norms and beliefs have been deeply established for centuries (Idang, 2015; UNEP 2011). These norms and beliefs have been creating a socio-cultural environment that defines the role of males and females within households and society. The division of gender roles between men and women guided by the socio-cultural environment has the impact that women differently engage in climate adaptation practices. Moreover, the intersectional aspects like ethnicity, caste, age, wealth, class, and capabilities also play a vital role while analyzing the climate change adaptation from a gender perspective (Goodrich, Udas, & Spencer, 2019).

The climate change adaptation studies from Africa and South Asia which have considered gender and socio-cultural environment reveal that the women's participation is different than that of men and is shaped by the socio-cultural environment. In Ghana, climate change is perceived and tackled differently by men and women, where, female farmers were found to be less resilient to floods and droughts (Bessah, et al., 2021). In the case of droughts in Sahel, Burkina Faso, culture bars the engagement of women in economic activities as economic activities have been one of the local climate adaptation strategies (Nielsen & Reenberg, 2010).

Similarly, in the case of South Asian context, the case from Bangladesh shows that, even though both men and women are increasingly facing various climate-related stresses, women are often being in risk and more vulnerable due to their limited access to social, economic, political, and cultural resources and opportunities (Ahmed & Kiester, 2021). In the same

geographical area, gender-related sociocultural norms have also been limiting women's participation in climate change adaptation-related activities (Naz & Saqib, 2021). Likewise, the case from Pakistan reveals that the women's low schooling years and access to the agricultural land negatively affect the females to the adaptation strategies to the flood hazards (Ashmad, Afzal, & Rauf, 2021). In the case of Nepal, the socio-cultural environment has influenced limiting the participation of women in climate change adaptation (UNEP, 2011). Further, the study from Onta and Resurreccion (2011) in Nepal also shows the importance of socio-cultural aspects within gender perspective in climate adaptation study because of its dependency and interconnectedness in society.

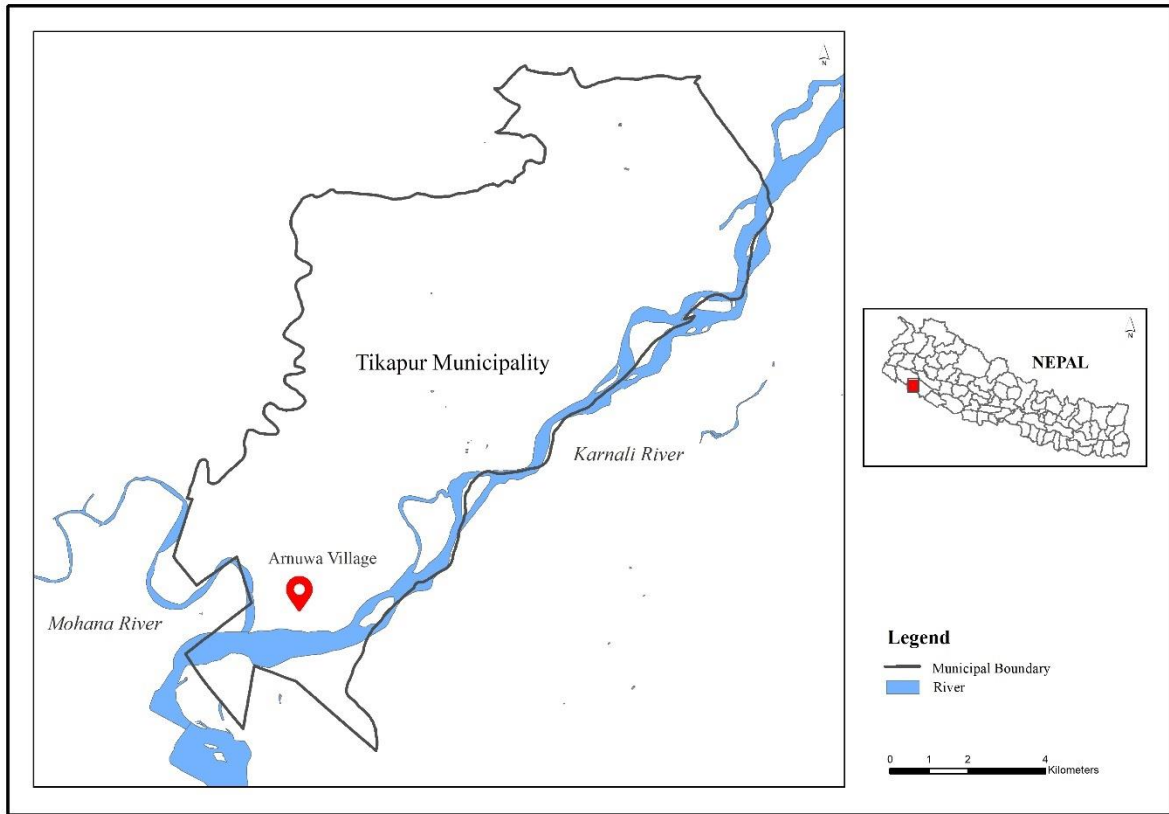
3. Methodology

The first part of the methodology chapter explains the rationale behind the selection of Arnuwa village from the lower Karnali river basin as an appropriate area for this research. The second section describes the methods of data collection and management. The third section discusses the data analysis and the presentation. And the last section of this chapter shows the framework of the research design.

3.1 Study area selection

Guided by the research questions, I was in search of an area that has been frequently affected by floods and also has a diverse socio-cultural environment. First, I have chosen an area that has been frequently affected by the riverine floods and associated inundation. The data from Bipad Portal (2022), a Nepal government platform that records the events of hazards and the impacts on the lives and properties of people, and the data from Tikapur municipality, show the repetition of floods events in the lower Karnali river basin of western Nepal. Out of the flood-affected villages, I have selected the lowermost village, Arnuwa, which is not only at risk from the Karnali river but also has risk from the Mohana river, a tributary of the Karnali River (see map 1). The houses in the village have been affected by the major floods at least two times in the last ten years. The recent devastating floods were in October 2021 which has affected all 173 houses in the village. The village geographically lies in 28⁰31'30" latitude and 81⁰07'15" longitude. The altitude of the areas is around 150 meters from the mean sea level.

Another requirement for the study area was the settlement living by diverse ethnic/caste groups of people. Like, Nepal is a multi-cultural country, and the same scenario was found in the Arnuwa village. The village was found inhabited by three major caste/ethnic groups of people. They are *Tharu*, a *Janajati* who are indigenous groups of people, *Brahmin/Chhetri*, who have migrated from the hill areas of western Nepal, and *Dalits*, who also have been living there since their ancestors. According to the caste system in the Hindu religion, there are four social divisions- they are *Brahmin*, *Chhetri*, *Baisya*, and *Sudra*. The *Tharu* community belongs to the *Baisya*, *Dalits* belong to the *Sudra* and *Brahmin/Chhetri* can be considered as almost similar types of categories regarding the culture they have.



Map 2 Arnuwa village, the study area



Photo 3: Arnuwa village flooded by October 2021 flood.

Photo credit- Chetan Khadka

3.2 Data collection

The total number of households in the Arnuwa village was 173. As the data from Tikapur municipality (2021) shows that all of them were affected by the 2021 October floods due to the Karnali river's embankment collapse, I have considered all of them as the potential candidate for my interview. Considering the time, I have drawn 83 samples for the individual interview. To select the sampled households, I first received a list of the 2021 October flood-affected households from the municipality. Then, I randomly selected the sample by using the online software, which was open access. A list of sampled households was prepared by using the main list. In order to tackle the unavailability of the sample household and or person during the interview, I have made a rule first to take the immediate next number and then the immediately previous number.

After I got approval from Norwegian Centre for Research Data (NSD), the individual questionnaire survey was conducted only with the female member of the sampled households. The questionnaire includes basic information about the households like location, type of house, population size, caste, and status of migration of the male members. About the individual data of the respondents, the questionnaire includes the age, education, occupation, and the status of the respondent as household head or not. Similarly, flood experience by the respondents, the availability of flood messaging and its types, adaptation practices, motivation factors, and the adaptation capacities were also included in the questionnaire. To take the interviews, I have visited the sampled households which were explored with the help of the previous respondents just like the snowball sample method supports finding out another with the support from the previous one. In the households, I explained the purpose of the visit to the adult members and then agreed to continue the interview with the adult female member. The interview was taken only with the female members arranging a separate place a bit far from other members but in a visible area. It took from 30 minutes to 45 minutes to complete the main part of the interview. The survey was done in a paper-based questionnaire.

After I collected and tabulated the quantitative data from the individual survey questionnaire, I found that the information would only better answer the research question 1, which is about exploring the socio-cultural status of women, and research question 2, which is about the flood hazard adaptation practices of women in Arnuwa village and partially research question 3,

which talks about the relations between research question 1 and 2. Then, I realized that I had to explore more about the causes behind the adaptation practices by different castes of women. Then, I conducted four in-depth interviews with the key informants and a group discussion. Three key informants were randomly selected representing three castes found in the village and one key informant was purposively selected from the local disaster management committee. The group discussion was conducted with seven women when they were taking part in cleaning the drainage which is also part of their irrigation canal cleaning that usually takes place every year before the monsoon begins. During the interviews, I explored the caste system at the local level, the status of newly migrated people from the hill (Brahmin/Chhetri), the status of Dalits, the flood hazard adaptation practices in general, the type of institutions/committees/groups formed and or available at the local level to deal with the flood and climate change adaptations, the status of women in general regarding the day-to-day life and so on.

3.3 Data management and analysis

In order to correct the data entry error from the paper-based questionnaire, the data was entered two times into different MS-Excel sheets and data validation to a range method was applied to check the entry error and corrected wherever the error was noticed. To answer the first research question i.e., the socio-cultural status of women, the data related to the caste, age, education, status as the household head, and so on were extracted with the help of pivot tables in excel and presented in the graphical form.

The same method of data analysis was applied to get the answer for the second research question i.e., engagement of women in flood hazard adaptation actions too. As there are five categories of adaptation actions by the women in the questionnaire, the five tables were generated in order to get the level of participation among the total respondents and later on presented in graphical forms.

Regarding the data analysis for the third research question, first, cross-tables were generated to get the similarities and differences in terms of engagement by women in different adaptation actions with a socio-cultural background like caste, educational status, and status of women as household heads. Second, to further dig into the relations and reasons for the level of engagement by women having different socio-cultural status, the data from key informant

interviews (KII) and group discussions were transcribed and used wherever relevant in the result sections.

3.4 Research design framework

While designing this research, first the literature related to the climate change adaptations was reviewed and the gaps were identified. Based on the gaps identified, three specific research questions were developed. Then research methodology to answer the research questions was designed where both qualitative and quantitative data were collected and analyzed. Based on the data generated, the result section was divided into three different sections linked with the research questions. At last, with support from the available literature, the findings were discussed, and the conclusion was drawn (see figure 1).

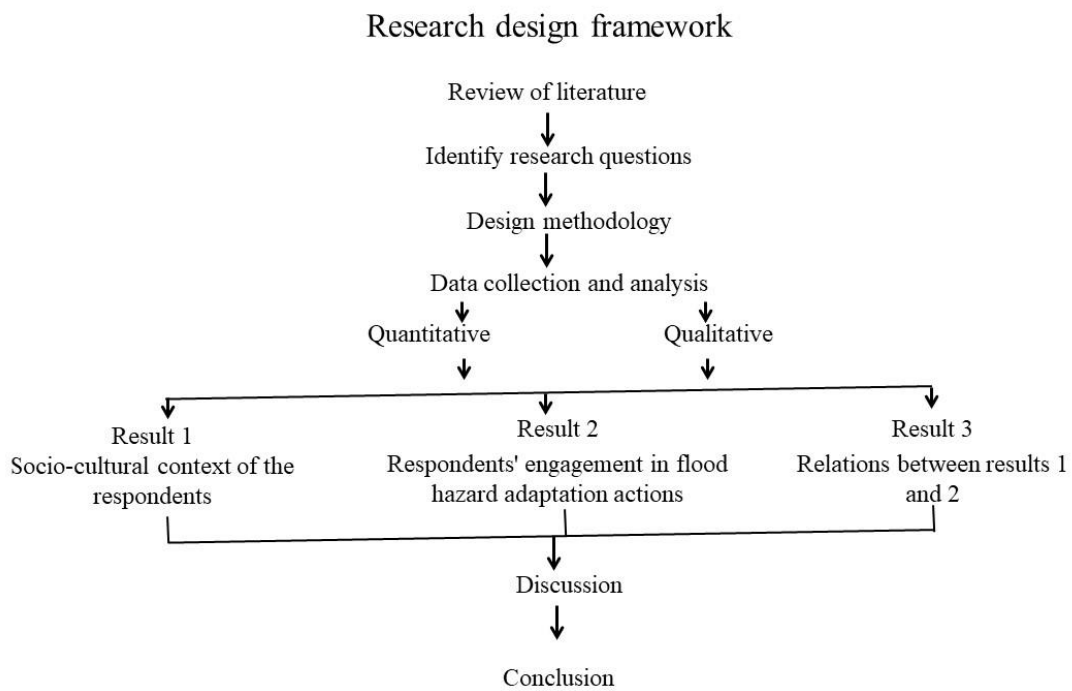


Figure 1: Research design framework

4. Results

This chapter presents the results of the three specific research questions. The first part of the chapter describes the women and their socio-cultural status like caste, education, and status as household heads. The second section describes the women's engagement in the different categories of flood hazard adaptation actions. The last section of this chapter analyses the relations between the socio-cultural status of women and their engagement in different adaptation actions.

4.1 Socio-cultural status of women

As per the objective of the study, all the respondents were adult female members of flood-affected households. Among the respondents, the youngest was 19 years old and the oldest one was 81 years old. The average age of the respondents was 45 years. If we look at the distribution of the respondents it seems the respondents' age group has been distributed to all the age groups, but the number is high within the 30-41 years age group followed by the age groups 41-63 (see figure 2), which is also the active age groups of people to be engaged in any kind of climate change adaptation practices.

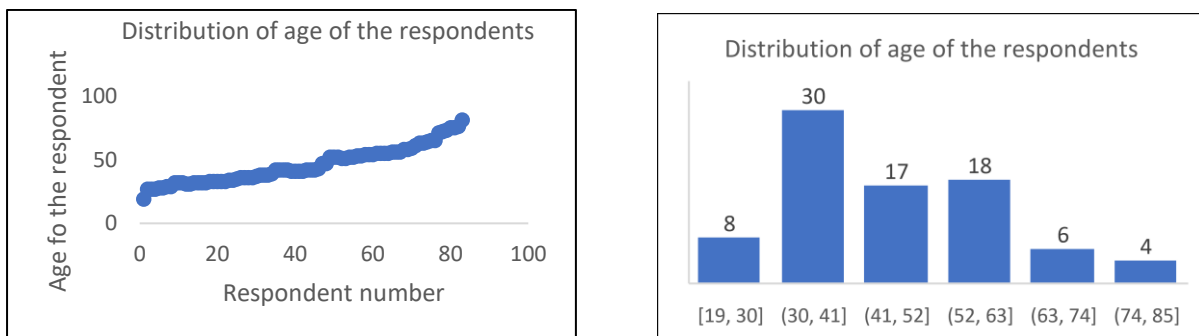


Figure 2: Distribution of age of the respondents

Source: Field survey 2022

While scoping the socio-cultural status of women in Arnuwa village, three major areas, the caste of the women, the education status, and the status of women as household heads have been considered.

4.1.1 Caste

Caste is one of the inevitable socio-cultural status of people in Nepal. Caste is a complex social system in the Hindu religion that has embedded in the so-called social hierarchy, occupation, settlement, and so on. There are four levels of social hierarchy in the Nepali caste system. They are *Brahmin*, *Chhetri*, *Baishya*, and *Sudra* respectively from the so-called upper caste to the lower one. *Brahmin/Chhetri* is the so-called upper caste then the hierarchy goes down to the *Tharu/Janajatis* which belong to the *Baisya* and then to the *Dalits* which belong to the *Sudra*, an untouchable in the Hindu caste system. Even though the social hierarchy according to the caste system and the associated discrimination/exclusion is forbidden by the laws, the remnant of practice is still there in the societies. In the case of Arnuwa, which lies in the terai region of Nepal, the caste can be further divided into the hill and terai linked with the origin of people. In this particular area of study, *Brahmin/Chhetri* from the hill is in-migrated. The women who live in Arnuwa village belong to three different castes, they are *Dalits*, *Janajatis*, and *Hill Brahmin/Chhetri*. Among the total respondents, the percentage of *Hill Brahmin Chhetri* is 44, *Terai Janajati* is 31, and *Terai Dalits* is 25 (see figure 3).

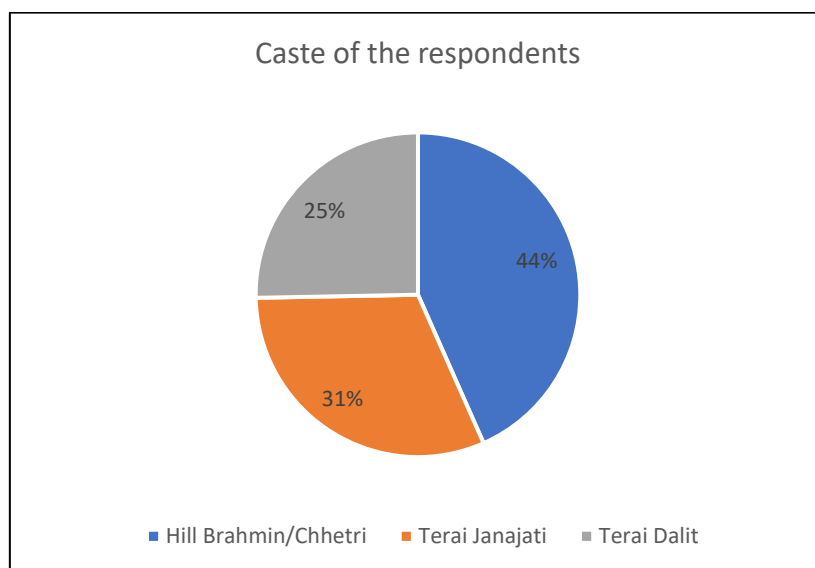


Figure 3. Caste of the respondents

Source: Field survey 2022

4.1.2 Education

Education is another aspect of people's lives that also connotes social status. Regarding the education of the women in Arnuwa village, the majority of them are illiterate, which means the person cannot read and write any texts or numbers. The percentage of illiterate women in Arnuwa is 47 out of 83 respondents. A person who can simply read and write the normal Nepali texts and can also calculate the simple accounts is considered literate. The percentage of literate women among the respondents is 36. 11 percent of the respondents have basic education and 6 percent have attended the secondary level of education.

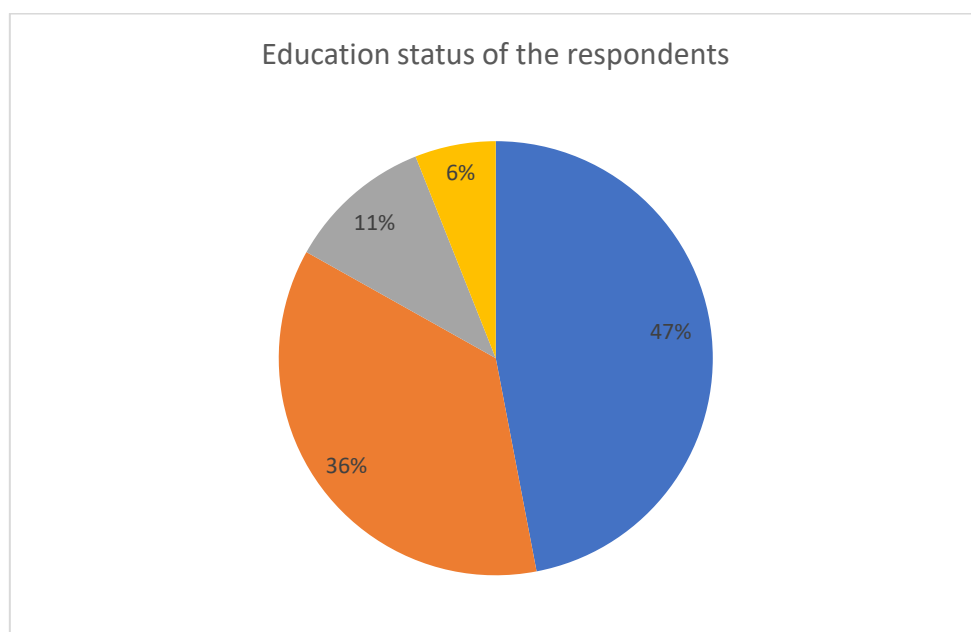


Figure 4. Education status of the respondent

Source: Field survey 2022

4.1.3 Household head

The person who is managing the household level responsibility overall is generally considered the household head. Usually, the household head is an elder person in a house who is taking care of everything within the household. Moreover, in the Hindu patriarchal society, the male elder member is considered the status of the household head. Among the 83 respondents, more than half of the women are taking the role of household head, which is 52 percent of the total respondents. In this study, the persons who are considered household heads are either the eldest

women of the house or the single or widowed women of any age, or the women whose male partners are absent for more than six months at the time of the interview.

4.2 Women's experience of the floods

In Nepal, the flood is associated with the monsoon season and is either riverine or flash floods. Usually, the monsoon season starts in June and ends in September. All the respondents replied that they had experienced the big floods and associated inundation at least two times in the last ten years. There were big floods in 2014, 2017, and 2021 in and around the study area. About the reasons for floods, the respondent evokes mainly two. Almost all the respondents said that the main reason for floods is persistent rain for a long period of time. In addition, around thirty percent of respondents had also mentioned that the intense rain has also equally contributed to the floods and inundation in their area.

4.2.1 Loss and damages of properties due to floods

Due to the floods, the people of Arnuwa experienced severe loss and damage to the lives of people and their properties in the village. All the respondents had replied that the flood had caused damage or loss to their crops. In Arnuwa village, all the respondents are related to farming in terms of their major occupation. The record from Tikapur municipality (2021) shows that the latest flood of October 2021 had caused severe damage to the paddy in the farmlands. In October 2021, because of unseasonal rain, the people faced huge floods which they have not thought about after the end of the monsoon season.

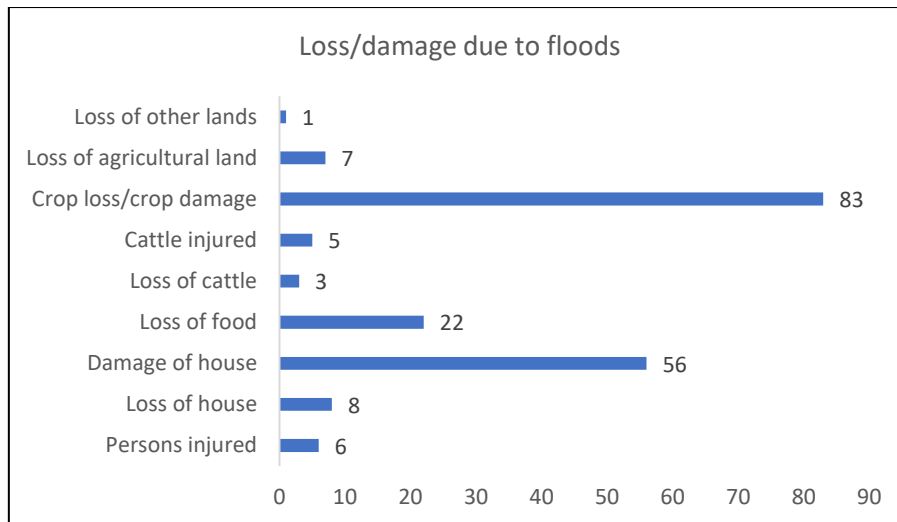


Figure 5: Loss/damages due to floods

Source: Field survey 2022

Two-thirds of the respondents replied that their houses were damaged by the floods. The damage to houses shall be linked with the types of houses too. Like the general types of houses in rural terai Nepal, Arnuwa village also mostly has a single-storied house made from thatch, bamboo, and mud. The percentage of these types of houses is 61.44. Following this, 33.73 percent of houses are made from brick and cement and are also single-storied. Only a few houses are two or more storied in their structure.

Around one-fourth of the respondents replied that because of the floods they had experienced losing their food items stored in their house. In addition to these big losses or damages, 10 percent of respondents lost their house, 8 percent lost their agricultural land, 7 percent reported that their family members got injured, 6 percent replied that their cattle got injured and 4 percent had lost their cattle. According to the group discussion, the common types of cattle in the villages are a cow, buffalo, goat, and chicken. In the flood, cow and buffalo can swim but the goats are reluctant to swim thus the floods usually affects the goats and chicken.

4.2.2 Women's experience in receiving flood messages

Regarding the experience of receiving messages about the floods, all the respondents replied that they had received messages about the floods from multiple channels. All the respondents had heard sirens during the floods. According to the group discussion, the siren is the most

common early warning messaging system in place that the people are following for a long. In the village, the villagers make a rule regarding the siren handling. There are assigned persons who receive the message from the flood measurement station located upstream. After s/he receives a message s/he blows the siren in different three ways. The first one is the single blow, which means the warning to the villagers about the possibility of a flood. The second one after the flood crosses the defined danger level. At this stage, there are two continuous blows from the siren. Third after the flood starts entering the village. In the third stage, there are continuous blows of sirens for a few minutes. The third type of siren message triggers the village to be evacuated to a safe place.

In addition to the siren, 76 percent of respondents replied that they had received messages from their traditional messaging system – *Badghar/Chaukidar*. *Badghar/Chaukidar* is a traditional institution in the *Tharu* community which used to govern the village in terms of resource utilization, common-pool resource management, and messaging to the villagers. Likewise, 39 percent of the respondents had received a message from their neighbors and 35 percent received messages about the floods on their mobile phones. Similarly, a few respondents had received messages through local radios, municipality officials, and television.

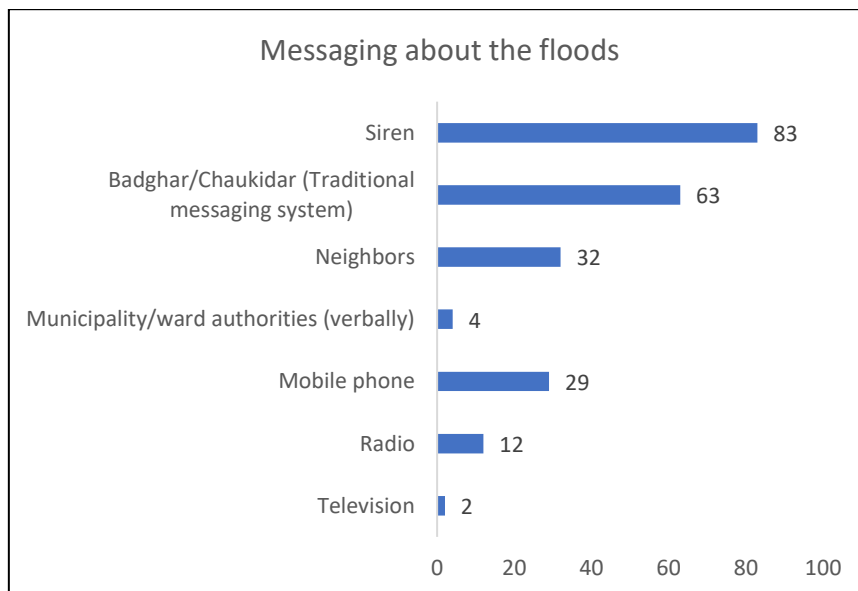


Figure 6. Messaging about the floods.

Source: Field survey 2022

4.3 Women's engagement in flood hazard adaptation actions

As flood is frequent in Arnuwa village, the engagement of people in the flood hazard adaptation actions is a regular way of life. The respondents replied that they got encouragement to act from different sources. All the respondents replied that they had been encouraged by the early warning system to act. The siren is the major component of the early warning system. Apart from the siren, there is a flood messaging system that automatically goes to the mobile numbers of the persons who are covered by the cell of mobile phone service providers alongside the Karnali riverbanks. The automated mobile messaging triggers after the river reaches the warning or danger level in the upstream gauge. Thirty-nine percent said that they were encouraged by their family members, friends, and neighbors, whereas 18 and 11 percent said that they were encouraged by the disaster management committee/groups and ward/municipality to take the adaptation action respectively.

During the survey, it was found that there was a maximum of 13 adaptation actions that the individual women were engaged with. But there are only two persons who replied that they had engaged in 13 actions. Whereas the minimum number of adaptation actions is one in which 5 women replied that they had engaged. The majority of the women responded that they engaged with 2-4 types of adaptation actions before, during, and after the floods in their village. (Figure 7).

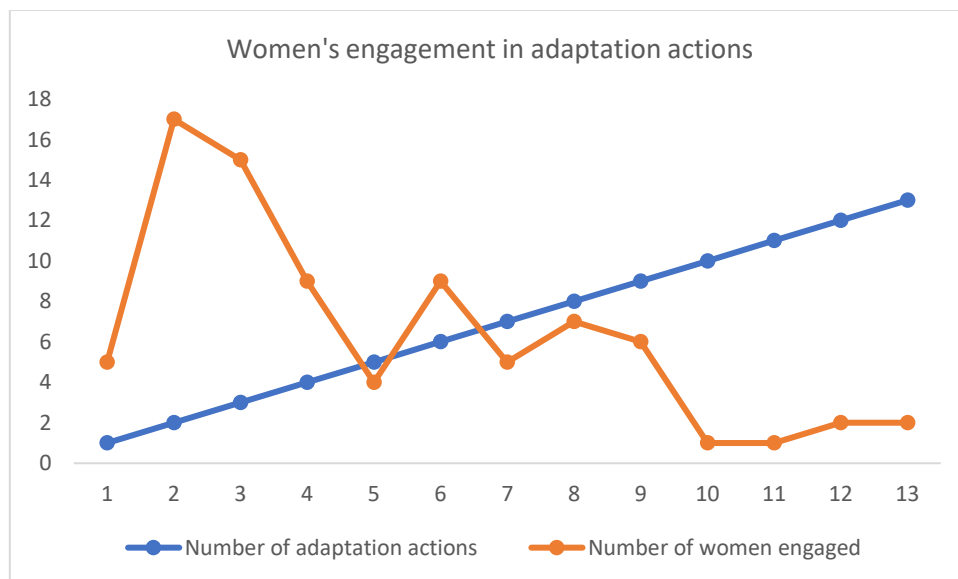


Figure 7: Women's engagement in adaptation actions

Source: Field survey, 2022

While designing the questionnaire, the adaptation actions were categorically divided into five. They were physical, ecosystem based, social, institutional and others. The below sections describe the engagement of women in different categories of adaptation actions in details.

4.3.1 Women's engagement in physical adaptation actions

Storage of the grains in a safe place, raising water pumps, raising the plinth level of the house, and using the sandbags to protect the house were considered under the physical adaptation actions in flood hazards. In the physical adaptation actions, 39 percent of the respondents replied that they had stored the grains on the shelves which are above the ground or the upstairs. Many houses in the study area are single-storied. The persons who have single-storied houses also build the shelves above the ground where they usually store their regular food items such as rice, flour, dry vegetables, and so on. When they must leave the house because of floods, they store the stuff on the shelves whatever possible to adjust. Similarly, the persons who have multi-storied houses store the stuff in their upper store in which they can accommodate almost all including the kitchen utensils.

Likewise, 16 percent replied that they had engaged themselves in raising the water pumps. As terai is the flat land, the water is the main problem during floods. There have been several projects from the government as well as non-government organizations which aim to support the individual households and the community building to raise the level of water pumps. Water pumps are the major source of drinking water in the study area.

Similarly, 12 percent of the respondents reported that they engaged themselves in raising the plinth level of the house. If we look at the type of houses in the study area, the majority of them are made from bamboo, thatch, and mud. The next type is the brick and cemented houses, and they are newly built. The women engaged themselves in raising the plinth level of the newly built houses.

The fourth physical adaptation action in floods is the use of sandbags or other materials like bamboo to build barriers or flood protection in the territory of the house. Usually, if the house is nearby the canal, then this type of practice is more common. During the survey, 7 percent of

the respondents replied that they have engaged themselves in using sandbags and other materials as an adaptation action.

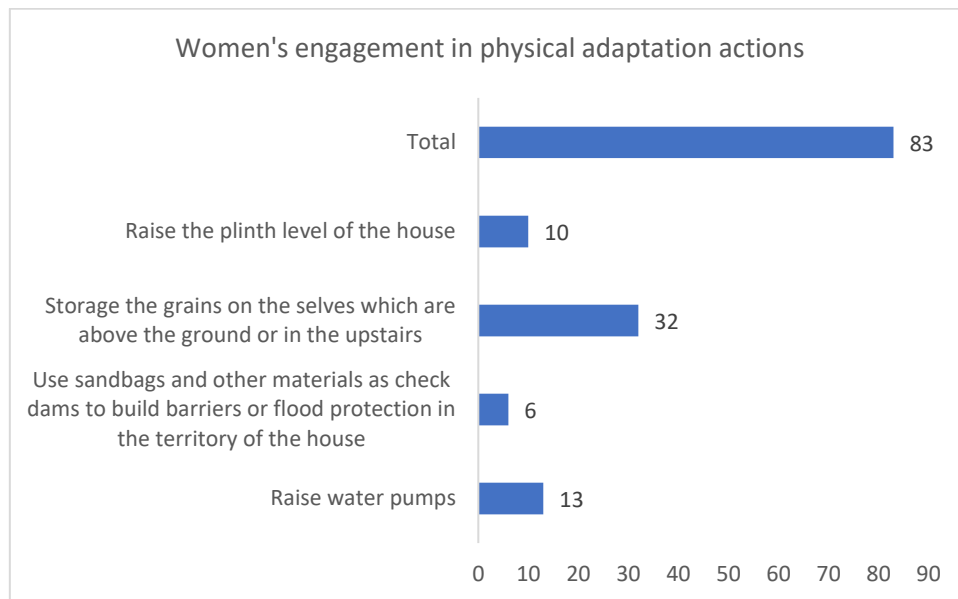


Figure 8: Women's engagement in physical adaptation actions

Source: Field survey, 2022

4.3.2 Women's engagement in ecosystem-based adaptation actions

In the ecosystem-based actions, even though there were four options provided with an open slot to get more options from the respondents, they had answered only one option i.e., the engagement in building check dams and embankments to save lands and houses from riverine floods. Only around 13 percent of the respondents had replied that they engaged in ecosystem-based adaptation action. As per the group discussion finding, Tikapur municipality has been implementing the activities relevant to the flood hazard mitigation measures such as building embankments and positioning sandbags to control the effect of flood. A similar list of activities can be found in the proposed activities recommended by the Local Adaptation Plan of Action of Tikapur municipality (LAPA, 2017)

4.3.3 Women's engagement in social adaptation actions

In the social adaptation actions, communicating with the neighbors, looking after the elderly and neighbors during the flood, support to build the community's safe place, and managing

food and non-food items were recorded from the survey. In the social adaptation actions, out of a total of 83 respondents, 28 percent of the respondents had reported that they had engaged themselves to warn/communicate with the neighbors when the flood is on its way or had occurred. Looking after the elderly relatives or neighbors before, during, and after the flood is another social action of adaptation in which 17 percent had engaged themselves. Likewise, six percent supported building a community safe place. With support from the municipality fund, the community has built a community safe place which is in the middle of the village made from cement and concrete. Two percent of the respondents had participated to manage food and non-food items.

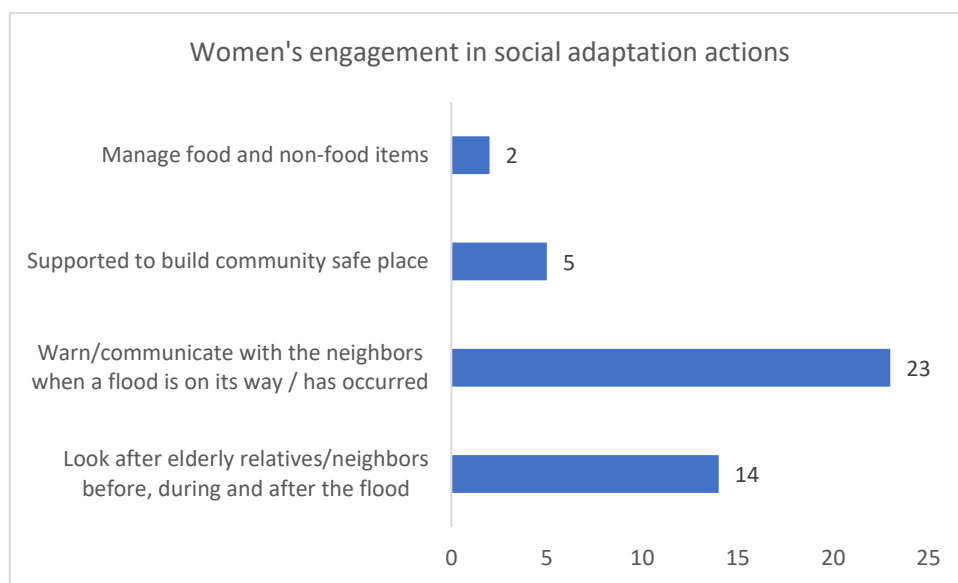


Figure 9: Women's engagement in social adaptation actions

Source: Field work, 2022

4.3.4 Women's engagement in institutional adaptation actions

Institutional adaptation actions, it is basically asking for support from the local disaster management committee, municipality, NGOs working in the sector of disasters, and community groups. Among the institutional actions, the popular one is to ask community groups for support. 37 percent of the respondents had asked other community groups for support. In the study area, the community groups in which the women are members are mostly the saving and credit groups. Similarly, 11 percent had asked both the disaster management committee and ward/municipality authorities for support. The disaster management committees are both at the ward and municipality levels. This is the committee government by

the disaster management act of the Nepal government. Whereas 5 percent had asked the NGOs working in the sectors of disaster for support during the floods. Because of the frequent flood areas, there are a couple of NGOs working in the sector of disaster management.

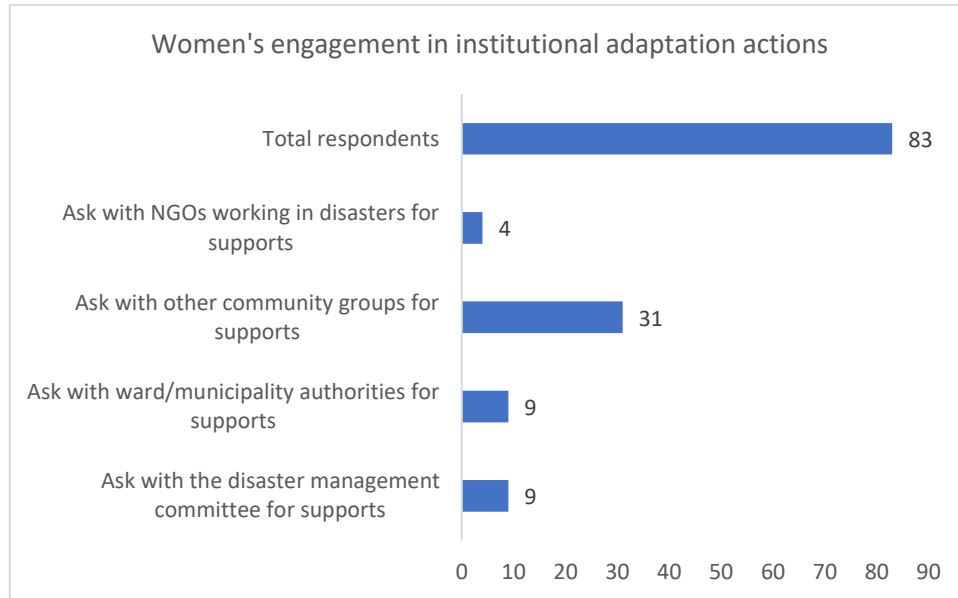


Figure 10: Women's engagement in institutional adaptation actions

Source: Field work, 2022

4.3.5 Women's engagement in other adaptation actions

Apart from the above groups of adaptation actions, the survey has also recorded other types of adaptation actions like moving to an area less exposed to floods, taking loose possession before the floods, transferring cattle and grains to a safe place, being prepared for the power cuts, live in the upstairs and the sell the grains. Here, except one, all other respondents had replied that they had moved to an area less exposed to the floods. As the area is flat, they do not have any other choice rather than moving to the less flood-exposed area. They take this action also because of the uncertainty of the exit of the water body from their place. Out of the total 83 respondents, 63 percent said that they took in loose possessions before the flood arrives. To take the loose possession, the early warning systems support them to get into the reality of flood exposure to their area. Likewise, 39 percent engaged themselves in transferring the grains/food items and cattle to a safe place. Regarding transferring cattle, they usually prioritize goats and chickens to get transferred as these two animals cannot survive in water. Similarly, regarding the grains/good items, the villagers use their traditional transportation means

“Dunlop”, which is a modified card by using the modern rubber tires. The number of respondents who engaged themselves in preparing for the power cuts was 24 percent. The story behind preparing for power cuts is that the authority cuts the power during the floods as the electric transmission system is too fragile in the study area. The same percentage of people replied that they sold the grains as an adaptation action to the possible floods. Selling grains is recent evidence in the study area. During the group discussion, the participants replied that they have been facing problems in finding out a safe place even though they were able to transfer the grains, so they have started emptying out the house before the flood so that they can be hassle-free from managing grains. At last, only a few people reported that they have stayed in upstairs during the floods.

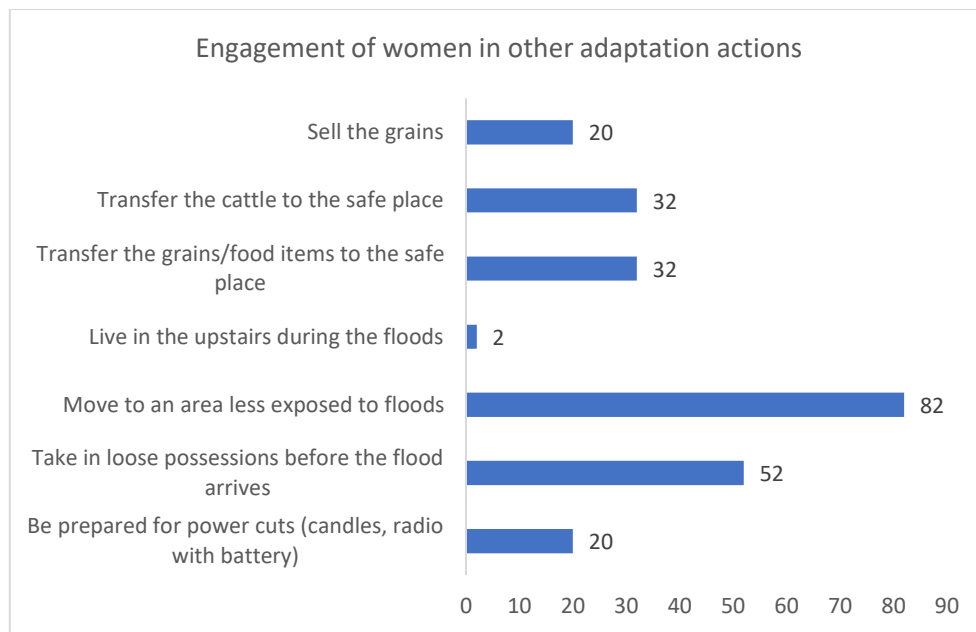


Figure 11: Women’s engagement in other adaptation actions

Source: Field survey, 2022



Photo 4: People moving out to the safe place during October 2021 flood

Photo credit: Chetan Khadka

Regarding the future possibility of floods in their area, all the respondents replied that they will be affected by the floods in the future too. All the respondents replied that their house is in a low-lying area and on the riverbanks thus they will be again affected. Likewise, 95 percent of the respondents have the perception that because of the single storied house they will be again affected by the future floods. Similarly, 64 percent of the respondents relate the flood with the building materials as they are not flood resistant. And 22 percent of the respondents believe that because of the insufficient members to move properties in emergencies, they will be affected by future floods.

Regarding the perceptions about the capacity to save lives and properties from the floods in the future, 95 percent believe that if they have more than a one-storied house, they can store the grains/food items. Similarly, 47 percent believe that their previous experience in dealing with flood events helps them to tackle floods again. An equal number of people, 34 percent think that having both male and female members in the house and support from the municipality/ward/disaster management committee's presence can help them during the floods. 24 percent of the respondents believe that their good health supports during the time of floods. There was only one respondent who replied that economic resources can support them to prevent life and properties in the flood events.

4.4 Relations between socio-cultural aspects of the women and their engagement in flood hazard adaptations

How the socio-cultural aspects have been shaping the engagement of women in Arnuwa village is the third research question of this study. To answer the research question, I have included all the adaptation actions that the women had engaged with, and the caste, education, and status of women as household heads regarding the socio-cultural aspect of women.

4.4.1 Castes and the women's engagement in flood hazard adaptation practices

Caste is the main socio-cultural aspect in the study area. The respondents belong to three different castes. They are *Hill Brahmin/Chhetri*, *Terai Janajati* and *Terai Dalits*. The table 1 below shows the percentage of women within each caste in terms of their engagement in different adaptation practices related to the flood hazards.

Table 1: Percentage of women within caste who had engaged themselves in different flood hazard adaptation practices

Adaptation practices	Caste		
	Brahmin/ Chhetri-Hill	Janajati- Terai	Dalit- Terai
Physical			
Raise water pumps	8.33	30.77	9.52
Use sandbags and other materials as check dams to build barriers or flood protection in the territory of the house	2.78	11.54	9.52
Storage the grains on the selves which are above the ground or in the upstairs	44.44	46.15	19.05
Raise plinth level of the house	0.00	30.77	9.52
Ecosystem based			
Build check dams and embankments to save lands and houses from river flood	2.78	26.92	14.29
Social			
Look after elderly relatives/neighbours before, during and after the flood	11.11	30.77	9.52
Warn/communicate with the neighbours when a flood is on its way / has occurred	27.78	38.46	14.29
Supported to build community safe place	2.78	15.38	0.00
Manage food and non-food items	5.56	0.00	0.00
Institutional			
Ask with the disaster management committee for supports	8.33	19.23	4.76
Ask with ward/municipality authorities for supports	8.33	19.23	4.76
Ask with other community groups for supports	22.22	42.31	57.14
Ask with NGOs working in disasters for supports	5.56	7.69	0.00
Others			
Be prepared for power cuts (candles, radio with battery)	30.56	30.77	4.76
Take in loose possessions before the flood arrives	61.11	50.00	80.95
Move to an area less exposed to floods	100.00	100.00	100.00
Live in the upstairs during the floods	5.56	0.00	0.00

Transfer the grains/food items to the safe place	44.44	46.15	19.05
Transfer the cattle to the safe place	44.44	46.15	19.05
Sell the grains	30.56	26.92	9.52

Regarding the women's engagement in different flood hazard adaptation practices, the total actions are 20. Out of the total 20 adaptation actions, *Terai Janajati* leads in 14. *Hill Brahmin/Chhetri* leads in three and *Terai Dalit* leads in two actions. In one action, all the castes have an equal level of engagement.

Under physical adaptation actions, there are differences in the level of engagement within the castes. In raising water pumps, *Janajati* has a higher level of engagement. The other two have almost equal but a lower level of engagement. The same level of engagement can be seen in raising the plinth level of the house. In this action, *Terai Dalit* has a lower level of engagement whereas *Brahmin/Chhetri* has no engagement. In using sandbags and other materials to protect houses and premises, all of the castes have a lower level of engagement. Whereas in saving the grains, all have a higher level of engagement, *Dalit* is a bit behind.

In relation to the ecosystem-based adaptation practices, as there is only one action, the engagement of *Terai Janajati* has the highest one followed by *Terai-Dalit* and then by *Hill-Brahmin/Chhetri*. Here, *Hill Brahmin/Chhetri* has far less engagement than the other two castes.

There are four adaptation actions under the category, social in which also *Terai Janajatis* has a higher percentage of engagement followed by *Hill-Brahmin/Chhetri* and *Terai-Dalit* respectively. Except for managing food and non-food items, *Terai Janajati* leads in other three actions i.e., looking after the elderly, warning/communicating with neighbors, and supporting the construction of the shelter. *Terai Dalit* has the lowest level of engagement in all four types of adaptation actions.

Following the trend of the other three adaptation sections, *Terai Janajatis* has a higher engagement level in institutional-related actions too. But regarding the specific adaptation action related to asking for support from other community groups, *Terai-Dalit* has the highest participation. In this category, *Terai Dalit* does not have any engagement in asking NGOs for support.

Similarly, in other adaptation actions, there is a mix of lead in terms of their participation. In preparing for power cuts, *Terai Janajatis* and *Hill-Brahmin/Chhetri* have a similar level of engagement, *Terai Dalit* has a higher level of engagement in terms of taking loose possessions before the flood arrives. All the castes equally move to an area less exposed to floods. In terms of transferring grains and cattle, *Terai Janajati* leads slightly more than *Hill-Brahmin/Chhetri* where *Terai-Dalits'* participation is only around less than half of the percentage of others.

Tharu community is the indigenous group of people living in this area for long. Agriculture is the main occupation of Tharus. As it is labor-intensive work, both males and females must equally participate. Apart from this, fishing in the nearby river is also a regular job of the Tharu community in which mostly female members participate. There is no rule inside Tharu houses where female is forbidden in Kitchen or any other activities during their mensuration period. Festivals are another means of participation where both Tharu males and females participate. If we look at the cultural dances, there is more engagement of Tharu females than males. Labour contribution to the common works such as cleaning the irrigation canals is the traditional practice in the Tharu community where both male and female equally participates.

KII-I

Brahmin/Chhetri in this area is migrated from the western hill. The outmigration of western-hill people to Indian cities for labor works has been a regular movement for generations. It is a saying that the people who used to go to India for work started settling down in this area during 2020s BS (1970s AD) after the eradication of malaria in the terai area of Nepal. Then slowly the number has been increasing. For the migrants to India, it is near for them too to visit their family compared to the long travel to the hill. Nowadays, usually male members migrate for work, and females and children stay in the home. The migrant from hill follows their culture strictly in terms of female participation during their mensuration period. During the mensuration period, women are forced to live separately and also are not allowed to touch cows and the gods. In addition, the hill people also follow some of the rules of Tharus like Badghar system in terms of

connecting with the messaging and the common works. People from the hill mostly live in a separate family having a smaller number of people.

KII- II

Dalits from Terai are indigenous groups of people who are living here for a long like Tharus. The major occupation of Dalit is agriculture.

Comparatively, Dalits own less land than Tharus. In agricultural work, both males and females participate. Another source of income for the household is wage labor. Apart from this some of the Dalits have been continuing the traditional work like blacksmith jobs and tailoring. In this occupation, there is less engagement of females.

There is no such discrimination between Dalits and Tharus. Dalits are allowed to visit Tharu's house but not the Brahmin/Chhetri's individual house. Even though Dalits live with Tharus, the culture is different as Dalit does not participate in all the cultural programs that the Tharu has been practicing for a long.

KII- III

Hence, the culture of the different caste also somehow influences the level of engagement by the women from different castes in flood hazard adaptation practices. The women from the Tharu community have been participating in household level, livelihood-related, and culture-related works and ceremonies equally and even more than men as they still rely on the subsidiary type of livelihood with contributions from all the family members continuing the indigenous culture. On the other side, the female of the *Dalits* does not engage themselves at the same level as Tharus mainly because of the cultural practices, and the type of blacksmith work as these are mostly men's works. Likewise, the women from the *Hill Brahmin/Chhetri* mainly concentrate on raising the kids and doing the household-level chores as they are living as a separate family.

4.4.2 Educational status and the women's engagement in flood hazard adaptation practices

The next socio-cultural status that I have taken is the educational level of the women. In terms of the education status, it is divided into four broad groups i.e., illiterate, literate, basic education, and secondary. Since the upper secondary and university level education was not found among the respondents in Arnuwa, the level as such does not make any difference except for reading out the messages on mobile phones and other available texts.

The women who have secondary education were found more engaged in raising water pumps, storage of grains in the upper store or selves above the ground, warning/communicating with the neighbors before, during, and after the floods, take loose possession before the flood arrives and transfer the cattle and grains. There are no such differences in the adaptation practices between the women having basic education and the women who are just literate. The level of engagement from the women who are illiterate is high in storage grains, asking the other community members for support and take loose possessions before the flood arrives.

Table 2: Percentage of women within educational status who had engaged themselves in different flood hazard adaptation practices

Adaptation practices	Education			
	Illeterate	Literate	Basic Education	Secondary Education
Physical				
Raise water pumps	10.26	20.00	11.11	40.00
Use sandbags and other materials as check dams to build barriers or flood protection in the territory of the house	2.56	13.33	11.11	0.00
Storage the grains on the selves which are above the ground or in the upstairs	38.46	36.67	33.33	60.00
Raise plinth level of the house	15.38	13.33	0.00	0.00
Ecosystem based				
Build check dams and embankments to save lands and houses from river flood	15.38	13.33	0.00	20.00
Social				
Look after elderly relatives/neighbours before, during and after the flood	7.69	26.67	22.22	20.00
Warn/communicate with the neighbours when a flood is on its way / has occurred	5.13	43.33	44.44	80.00
Supported to build community safe place	2.56	13.33	0.00	0.00
Manage food and non-food items	0.00	3.33	11.11	0.00
Institutional				
Ask with the disaster management committee for supports	5.13	20.00	0.00	20.00
Ask with ward/municipality authorities for supports	5.13	20.00	0.00	20.00
Ask with other community groups for supports	43.59	36.67	11.11	40.00
Ask with NGOs working in disasters for supports	0.00	10.00	0.00	20.00

Others				
Be prepared for power cuts (candles, radio with battery)	17.95	33.33	22.22	20.00
Take in loose possessions before the flood arrives	69.23	56.67	44.44	80.00
Move to an area less exposed to floods	2.56	0.00	0.00	0.00
Live in the upstairs during the floods	0.00	0.00	22.22	0.00
Transfer the grains/food items to the safe place	38.46	36.67	33.33	60.00
Transfer the cattle to the safe place	38.46	36.67	33.33	60.00
Sell the grains	20.51	30.00	22.22	20.00

4.4.3 Status as a household head and women's engagement in flood hazard adaptation practices

The third socio-cultural aspect the study has considered is the status of women as household heads. In the relations between the women's status as household heads and their engagement in flood hazard adaptation practices, there are fundamental variances in seven adaptation practices only. In the adaptation actions, the women who are heading the household have more engagement in raising water pumps, asking for other community groups for support, support to build a community safe place, taking in loose possessions before the flood arrives, and selling the grains. These all activities can be linked to the rights and responsibilities of women as household heads. The household head is usually obliged to make the decision within the household and also to contact the community.

Table 3: Percentage of women within the status of household head who had engaged themselves in different flood hazard adaptation practices

Adaptation practices	Household head	
	Yes	No
Physical		
Raise water pumps	23.26	7.50
Use sandbags and other materials as check dams to build barriers or flood protection in the territory of the house	9.30	5.00
Storage the grains on the selves which are above the ground or in the upstairs	39.53	37.50
Raise plinth level of the house	11.63	12.50
Ecosystem based		
Build check dams and embankments to save lands and houses from river flood	13.95	12.50
Social		
Look after elderly relatives/neighbours before, during and after the flood	11.63	22.50
Warn/communicate with the neighbours when a flood is on its way / has occurred	18.60	37.50
Supported to build community safe place	9.30	2.50
Manage food and non-food items	0.00	5.00
Institutional		
Ask with the disaster management committee for supports	11.63	10.00
Ask with ward/municipality authorities for supports	11.63	10.00
Ask with other community groups for supports	48.84	25.00
Ask with NGOs working in disasters for supports	4.65	5.00

Others		
Be prepared for power cuts (candles, radio with battery)	25.58	22.50
Take in loose possessions before the flood arrives	100.00	22.50
Move to an area less exposed to floods	0.00	2.50
Live in the upstairs during the floods	0.00	5.00
Transfer the grains/food items to the safe place	39.53	37.50
Transfer the cattle to the safe place	39.53	37.50
Sell the grains	39.53	7.50

5. Discussion

The people and their properties in Arnuwa village have been frequently affected by the riverine floods from Karnali and or inundation (Tikapur Municipality 2021). The people have experienced floods at least two times in the last ten years. The reason that the majority of people see floods is the persistent rain for a long period of time and also the intense rainfall. The experience of flood events by the people and the cause they had stated during an interview can be further justified by the report of the Nepal government as it says the frequency of climate-related extreme events like intense precipitation and water-related hazards are increasing (MoFE, 2019). The historical data from the Government of Nepal in the same catchment areas also show a similar scenario (Bipadportal, 2022).

Women in the Arnuwa village have engaged themselves at least in two adaptation actions in the previous flood cases. The maximum adaptation actions carried out by individuals are thirteen. On average, the women had practiced five adaptation measures, but the majority of people have practiced two-four actions. The result can be linked with the statement by Adger et al. (2013), Hegger et al., (2017), and Brink and Wamsler (2019) who have claimed that the citizens' engagement in climate change adaptation has been crucial and even becoming decisive where the mandate and capacity of local government are insufficient. Oxford Policy Management (2020) justifies the narrative in the case of Nepal as it says the local government of Nepal, which is mandated for disaster management at the local level has limited capacity.

All the women perceive the risk of being affected by floods in the future. As Canon et al. (2014), argues about the willingness or rejection of adaptive measures significantly inspired by the perception of risks (Cannon et al. 2014), the women in Arnuwa village are likely to continue the adaptative measures in future floods too. Further, they replied that they took the adaptative actions because of the messaging by the early warning systems, encouragement by family/friends/neighbors, and the local disaster management committees/groups as well as ward/municipality offices.

The finding of this study is in line with the study by Datey et al (2021) in Laddakh Pakistan where they have proved that there are also instances that women also have active roles and engagement regarding climate change adaptation activities. The study from Laddakh, Pakistan

shows that, even though men and women experience climate variability and disasters differently and women are the most vulnerable groups to climate extreme events, they are actively taking part in climate adaptation-related works within their community and also playing a positive influencer role.

The types and the number of flood hazard adaptation actions that the women had engaged in within the study area further prove the importance of gender lens in the climate change adaptation studies as argued by Naulu and Verrall (2021).

Further, Eaglay and Wood (2012) explain the social role theory and argue that climate change adaptation studies that only focus on male-female folds theoretically ignore the aspect of “gender” as it considers reference to social and cultural differences rather than biological ones. Yulia (2010) further clarifies that as many aspects of social life are gendered, it is essential to give proper attention to put the gendered lens to get into the complexities of society. In addition, Pradhan and Shrestha (2005) add that the diverse caste and ethnic groups with distinctive cultures in Nepal have an impact on diverse participation in various sectors (Pradhan & Shrestha, 2005). The study has considered the socio-cultural environment in exploring the adaptation measures by the women. The adaptation practices by the women have been linked with their caste, education, and status as household heads.

Caste is one of the main social-cultural aspects in the study area and in Nepal which often shapes the level of engagement in different actions within the society. There were three castes recorded during the study which are *Hill Brahmin/Chhetri* which so-called upper caste in the caste system of Nepal. The second was the *Janajatis* from the Terai region which is considered in the middle of the caste system. The third one was the Terai *Dalit* which has been considered an untouchable caste in many societies for generations even though the legal provisions deny it. Regarding the caste-wise engagement of women, there are huge differences between the *Terai Janajati* and the other two castes i.e., *Hill Brahmin and Terai Dalit*. Out of twenty adaptation practices, *Terai Janajati* has more engagement in fourteen actions. Likewise, in other socio-cultural aspects i.e., education and status of women as household head the women having those status leads in the twelve and thirteen adaptation actions respectively. The evidence supports the arguments that gender is not only knotted within the intra-household dynamics but to the wider social relations (see Daoud, 2021). The findings can be further linked

with the statements by Ashmed and Kiester (2021) and Gracia et al. (2020) where they have stated that climate change affects people differently due to the socio-cultural environments and this result in varied adaptation strategies by the people.

The types of diverse participation by all the women from different caste in the climate change adaptation actions can be linked with the study by Naz and Saqub (2021) in Bangladesh where they have argued that gender-related socio-cultural norms limits women's participation in climate change adaptation-related activities. The finding further relates to the study by UNEP (2011) which has revealed that the socio-cultural environment has influences in limiting the participation of women in climate change adaptations.

6. Conclusion

In conclusion, the women in Arnuwa village which lie on the riverbanks of lower Karnali have been facing floods many times. The last one was the unseasonal floods in October 2021 which shall be linked with the climate extreme event as the regular monsoon period in Nepal is June-September. The major effects of the frequent floods are crop loss in the field, damage to houses, and the loss of grains stored inside the house. The women in Arnuwa village have been engaging themselves in different types of adaptation practices.

Like other areas of Nepal and the South Asian context, the diverse ethnic/caste of people live in the small village, Arnuwa. They are- *Hill Brahmin/Chhetri*, *Terai Janajati* and *Terai Dalit*. Regarding the engagement of women in flood hazard adaptation action, there are differences according to the caste of people. In the caste-wise engagement analysis, *Terai Janajati* has the higher level of engagement which is fourteen out of a total of twenty adaptation actions related the flood hazards. Where *Hill Brahmin/Chhetri* has more engagement in three and *Terai Dalit* has only on two actions.

Not only the caste, the education level of women, and the status of women as household heads have also influenced the engagement of women in adaptation actions. The women with higher education levels have leading engagement in twelve adaptation actions. Likewise, the women leading the household have more engagement in thirteen types of adaptation actions.

Hence, regarding the climate change or flood hazard adaptations, the socio-economic status of people influences a lot. Thus, the study which focuses on gender in climate change adaptation should also give special attention to the socio-cultural aspects.

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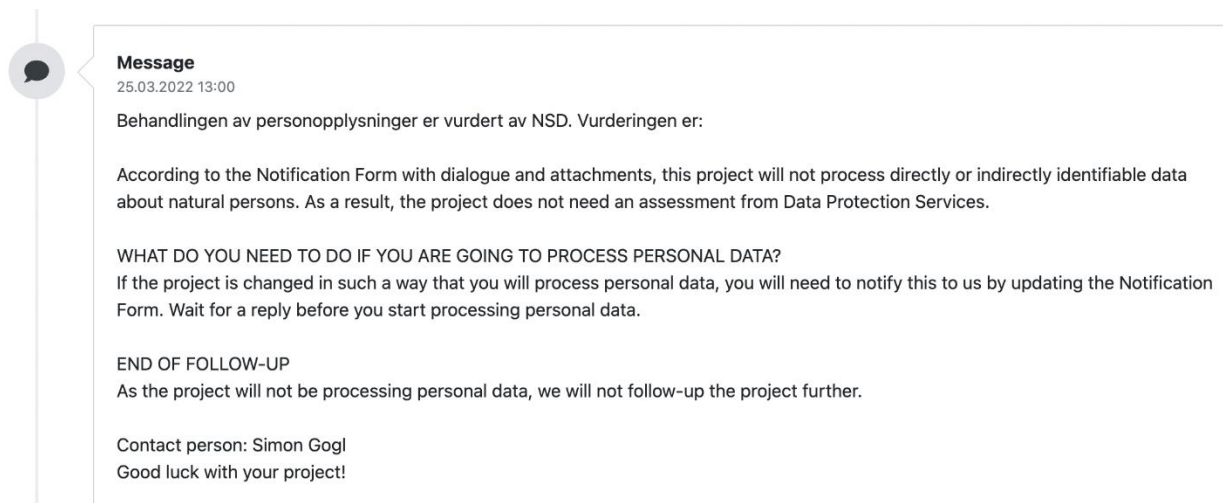
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Annexes

Annex 1 : Notification from NSD about the approval

Screenshot of the message from NSD.



Women’s engagement in flood hazard adaptation in Nepal

Individual Survey template

Introduction: “Namaste, do you have around 30 minutes to speak to me about your experience in the flood hazard adaptation? I would like to ask you some questions to help me as I need to conduct this survey to complete my master’s thesis. I expect your honest answers. Your identity will not be disclosed, and the information will not be used against you in any way. This interview is voluntary – you do not have to answer a question if you don’t want to, and we can stop at any time”.

General Information

Q.No.	Question	Options
101	Interview number	Number.....
102	Date of interview	Day/Month/Year
103	Time interview start	Hour/Minute.....
104	Time interview finish	Hour/Minute.....
105	District	Kailali
106	Municipality	Tikapur
107	Ward	8
108	Tole (Hamlet)	Name of the tole.....
109	Type of the house	One storied made from thatch, bamboo and mud Two or more storied made from thatch, bamboo and mud One storied made from cement and brick Two or more storied made from cement and brick One storied made from wood Two or more storied made from wood

Household-level information

201	Is the respondent household head?	Yes No
202	What is the caste of the respondent?	Brahmin Chhetri (Terai) Brahmin Chhetri (Hill) Janajati (Terai) Janajati (Hill) Dalit (Terai) Dalit (Hill) Not applicable
203	What is the age of the respondent	Age.....
204	What is the education of the respondent?	Illiterate Literate Basic (Below 8 standard) Secondary (8-12 standard) University (above 12 standards)
205	What is the occupation of the respondent?	Farming Business Service Daily wage labor Others (Please specify).....
206	What is the total number of members of your household including yourself in each age bracket?	Male (0-5)..... Male (6-17)..... Male (18-59)..... Male (60+)..... Female (0-5)..... Female (6-17)..... Female (18-59)..... Female (60+).....
207	Do the male members in your family become absent due to migration during the monsoon periods?	Yes No

208	Are you a member of any Disaster Management related groups?	Yes No
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Flood experience

301	How many times did you experience floods in the last ten years?
302	Do you know what caused the floods?	Intense rain After a dry period Persistent rain for a long period Snow/Ice melting Don't know
303	What were the major losses due to the floods?	Loss of life Persons injured Loss of house Damage of house Loss of food Loss of cattle Cattle injured Crop loss/crop damage Loss of agricultural land Loss of other lands Others (Please specify)

Flood messaging

401	Do you receive the message about the flood?	Yes No
402	How do you receive the messages about the flood?	From television From radio From mobile From municipality/ward authorities (verbally) From neighbors

		From Badghar/Chaukidar (Traditional messaging system) From the siren Don't know
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Adaptation action

501		Have you done any of the following to protect people or property from floods (before, during, and after)?
502	Physical	Raise water pumps
		Use sandbags and other materials as check dams to build barriers or flood protection in front of the house
		Storage the grains on the selves which are above the ground or in the upstairs
		Raise the plinth level of the house
		Others (please specify).....
503	Eco-system based	Build check dams and embankments to save lands and houses from river flood
		Reforestation/afforestation activities in the riverbanks
		Flood resistant/ deep-rooted crops
		Practice no-tillage crops
		Others (please specify).....
504	Social	Look after elderly relatives/neighbors during the flood
		Warn/communicate with the neighbors when a flood is on its way / has occurred
		Supported to build community safe place
		Manage food and non-food items
		Others (please specify).....
505	Institutional	Ask with the disaster management committee for supports
		Ask with ward/municipality authorities for supports

		Ask with other community groups for supports
		Ask with NGOs working in disasters for supports
		Others (please specify).....
506	Others	Be prepared for power cuts (candles, radio with battery)
		Take in loose possessions before the flood arrives
		Move to an area less exposed to floods
		Live in the upstairs during the floods
		Live in a separate place than house during the floods
		Transfer the grains/food items to the safe place
		Transfer the cattle to the safe place
		Others (please specify).....

Motivation

601	What factors motivate you to take actions of your own to reduce the risk of damage from potential floods?	<p>I am encouraged by family members, friends, neighbors to take action</p> <p>I am encouraged by the ward/municipality to take action</p> <p>I am encouraged by the Disaster Management committee/groups to take action</p> <p>I am encouraged by the early warning system to take action</p> <p>Taking action has low or no cost</p> <p>Others (please specify).....</p>
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Adaptive capacity

701	Do you think that the flood will affect your life and property in the future?	<p>Yes</p> <p>No</p>
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702	If yes, why do you perceive that the flood will affect you?	<p>My house is in the low lying area</p> <p>My house is on the river banks</p> <p>I have single storied house</p> <p>My house's building materials are not flood resistant</p> <p>I don't have sufficient members to move our properties in emergencies</p> <p>Others (please specify).....</p>
703	Which resources do you think are most important for your capacity to deal with flood events?	<p>Economic resources</p> <p>More than the one-storied house where the grains/goods can be stored</p> <p>Having both male and female members at the house</p> <p>Family, relatives, and friends living nearby</p> <p>Good health</p> <p>Experience in dealing with previous flood events</p> <p>Technical or construction-related knowledge</p> <p>Access to tools, machines, or other equipment</p> <p>Support from the municipality/ward/disaster management committees</p> <p>Others (please specify).....</p>

Annex 3: Key Informant Interview and Focus Group Discussion checklist

What are the reasons behind the following adaptation practices by women in Arnuwa village

Physical

Raise water pumps

Use sandbags and other materials as check dams to build barriers or flood protection in the territory of the house

Storage the grains on the selves which are above the ground or in the upstairs

Raise plinth level of the house

Ecosystem based

Build check dams and embankments to save lands and houses from river flood

Social

Look after elderly relatives/neighbours before, during and after the flood

Warn/communicate with the neighbours when a flood is on its way / has occurred

Supported to build community safe place

Manage food and non-food items

Institutional

Ask with the disaster management committee for supports

Ask with ward/municipality authorities for supports

Ask with other community groups for supports

Ask with NGOs working in disasters for supports

Others

Be prepared for power cuts (candles, radio with battery)

Take in loose possessions before the flood arrives

Move to an area less exposed to floods

Live in the upstairs during the floods

Transfer the grains/food items to the safe place

Transfer the cattle to the safe place

Sell the grains

Are there any specific rules and regulations in terms of women's participation in different activities including the flood hazard adaptation in each caste?