UNDERSTANDING CLIMATE CHANGE AND ROLE OF COMMUNITY FORESTRY GOVERNANCE IN CLIMATE ADAPTATION: CASES FROM UDIPUR, LAMJUNG

A Dissertation Submitted to

CENTRAL DEPARTMENT OF ENVIRONMENTAL SCIENCE
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In Partial Fulfillment of the Requirements for the Award of Degree of
M.Sc. in Environmental Science

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DECLARATION

I hereby declare that the work presented in this dissertation is a genuine work done originally by me and has not been submitted anywhere for the award of any degree. All the sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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RECOMMENDATION

This is to certify that **Mr. Regan Sapkota** has completed this dissertation work entitled **"Understanding Climate Change and Role of Community Forestry Governance in Climate Adaptation: Cases from Udipur, Lamjung"** as a partial fulfillment of the requirements of M.Sc. in Environmental Science under our supervision and guidance. To our knowledge, this research has not been submitted for any other degree, anywhere else.

We therefore, recommend the dissertation for acceptance and approval.

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LETTER OF APPROVAL

On the recommendation of supervisors "Prof. Dr. Kedar Rijal" and "Dr. Bimal Raj Regmi", this dissertation submitted by **"Mr. Regan Sapkota"** entitled **"Understanding Climate Change and Role of Community Forestry Governance in Climate Adaptation: Cases from Udipur, Lamjung"** has been approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements of M.Sc. in Environmental Science.

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CERTIFICATE OF ACCEPTANCE

This dissertation entitled **"Understanding Climate Change and Role of Community Forestry Governance in Climate Adaptation: Cases from Udipur, Lamjung"** submitted by **"Mr. Regan Sapkota"** has been examined and accepted as a partial fulfillment of the requirements of M.Sc. in Environmental Science.

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Abstract

Local communities are considered more vulnerable to climate change due to their low adaptive capacity. In Nepal, many adaptation practices have been carried out to reduce its impacts by different institutions, Community forestry (CF) is one of them. CF in Nepal is considered as one of the successful institutions of Nepal and good governance of it is considered as the pillar of its success. Limited research was done to assess the governance status of the CF but the role of CF governance in climate adaptation is rarely studied. Thus, this study is done in Udipur VDC of Lamjung district to assess the climate trend, status of the governance and its role in adaptation practices and to find the major facilitating and constraining factors for climate adaptation. Primary data were collected via HHs survey, FGD, KII, and DHM data were also used. A total of 230 HHs survey, seven FGD, and 10 KII were done in seven CFs of Udipur. Different statistical tools like Microsoft excel 2016, XLSTAS, SPSS, and NVivo 11 were used to analyze the data. The study found that precipitation pattern in Udipur has been erratic whereas temperature is on increasing trend. Winter months are getting less cold and summers are getting hotter. Analysis of people's perception found that local people of Udipur have good understandings of major parameters of climate change. Meanwhile, a mathematical approach was developed to find the status of each CF in percentage. It was found that among seven CF of Udipur, Kalika CF had the best governance status (79.32%) while Manakidanda CF was among CF with the weakest governance status (58.70%). Similarly, Kalika had the highest number of adaptation activities (28) carried out on it, whereas Manankidanda (7) had the lowest. The study found that good governance had huge to play during climate adaptation process; better the governance higher was the adaptation practices. Moreover, the facilitating factors (good governance, access to adequate infrastructure, access to technology and others) and the constraining factors (poor awareness of adaptation among local people, inadequate support from government, inadequate budget of CF for adaptation, and others) identified by this study will help the policy makers and the practitioners to address climate change adaptation in more effective way in Nepal.

Keywords: *community based adaptation, local institutions, facilitating factors, constraining factors*

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Abbreviations and Acronyms

ADB	Asian Development Bank
BCF	Bankali Community Forest
°C	Degree Celsius
CBS	Central Bureau of Statistics
CDES	Central Department of Environmental Science
CF	Community Forest
CFUGs	Community Forestry User Groups
DDC	District Development Committee
DFO	District Forest Officer
DFRS	Department of Forest Research and Survey
DFSP	District Forestry Sector Plan
DHM	Department of Hydrology and Meteorology
DoF	Department of Forests
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GCF	Gyadipakha Community Forest
GLOF	Glacial Lake Outburst Flood
HHs	Households
HI-AWARE	Himalayan Adaptation, Water and Resilience
HoD	Head of Department
ICAO	The International Civil Aviation Organization
ICIMOD	The International Centre for Integrated Mountain Development
IDS	Integrated Development Society
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
ISET	Institute for Social and Environmental Transition
JCF	Jwaladevi Community Forest
KCF	Kalika Community Forest

KII	Key Informant Interview
MCF	Mandali Community Forest
MdCF	Manakidanda Community Forest
MoFSC	Ministry of Forest and Soil Conservation
MoPE	Ministry of Population and Environment
NAPA	National Adaptation Programme of Action
NCCSP	Nepal Climate Change Support Programme
NCVST	Nepal Climate Vulnerability Study Team
PCF	Patalepani Community Forest
TU	Tribhuvan University
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	The United Nations Framework Convention on Climate Change
VDC	Village Development Committee
WWF	World Wildlife Fund

CHAPTER 1: INTRODUCTION

1.1 Background

Intergovernmental Panel on Climate Change defines climate change as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. The standard average period is taken as 30 years. IPCC (2007) concluded that "since the beginning of the mid-20th century and to the present, the variation in global average temperature is considered to be driven by anthropogenic greenhouse gas concentrations". Furthermore, if the situation doesn't change, then the average global surface temperature will be found to have increased in the range between 2°C to 6°C (Riebeek, 2010).

Climate change is an issue of serious concern in the field of sustainable development. (ICAO, 2012). The variation in hydro-meteorological pattern due to climate change will cause adverse impacts upon the economic and social sectors such as water resources, agriculture, forestry, fisheries and even human settlements (Bhatta, 2011). Climate change is bound to convey unpredictability with respect to the climatic phenomenon and which could aid in extreme events such as heavy rainfall, floods, droughts, storms, lightning, etc., because of which human population dependent on the water resources, agricultural, forestry, fisheries to make their living will be affected adversely (Adger et al., 2003; Baker et al., 2012; Bharati et al., 2012; Dixit et al., 2016; Gurung et al., 2013; Hua, 2009; IPCC, 2007; OECD, 2009b). Due to the poor investment in adaptation practices, people in the developing countries are suffering more in comparison to developed countries, as a result climate change impacts (IPCC, 2001).

Climate change is attributing to major changes in Nepal like changes in the rainfall and temperatures. There is uncertainty with regards to the seasons, as the monsoon becomes shorter and heavy rainfall more frequent while warming increases throughout the year (Ramasamy & Regmi, 2014). The current rate of increase in temperature is expected to accelerate the recession of glaciers and snowfields that may affect seasonal and annual water yields and flow in the rivers (Gurung, 2002). Erratic and extreme precipitation events are also likely to accelerate recurrent water-induced disasters like floods, landslides, soil erosion, sedimentation and drought (Dixit et.al., 2016). It is no doubt that everyone will get affected by the adversities of climate change, but it is also certain that poor countries like Nepal are likely to suffer more because of limited support to cope up

with the enduring impacts of climate change (Regmi et al., 2010). In addition, Nepal is a country with extremely complex topography which makes it more vulnerable to climate induced hazards as droughts, floods, landslides, windstorms, hailstorms, cold waves, disease epidemics, glacial lake outburst flood, fires and earthquake (WFP, 2009).

Climate change adaptation is crucial to safeguard the lives and livelihood of millions of people mostly residing in developing countries as they are more vulnerable to its impacts. IPCC defines climate adaptation as the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences. Climate change adaptation can vary with the intent/focus and is generally categorized based on intent, purpose, and timing. It can be distinguished into various types, including "anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.".

Nepal has also practiced many climate adaptation practices, one of them include community based adaptation practice. Evidence shows that community based approaches are practical adaptation actions whose implementation done through 'learning by doing' process (UNFCCC, 2007). Community based natural resources management program such as Community Forestry (CF) has been effectively taking place in most part of Nepal since the 1980s. It is the bottom up approach of the government in which local people are the leader of forestry activities. According to 2016 community forestry bulletin of Nepal, there are 18,960 community forest user groups in Nepal managing more than 1.8 million hectares (Ha) of forests, the number itself suggests the priority of the government in community forestry program as one of the adaptation practices.

The local institutions are taking a key role in facilitating community-based adaptation (Agrawal, 2008; Jones & Boyd, 2011; Koch et al., 2007). In Nepal, among others Community Forestry User Groups (CFUGs) are used as institutions to design, plan and implement adaptation initiatives. The Community Forestry program of Nepal is considered to be participatory, inclusive, accountable and transparent management system and is regarded as a successful people centric program. Still, some community forestry in Nepal is functioning well while others are not. Research says good governance have a huge role to play in the success of the community forestry thus helping to reduce climate vulnerability (Lamichhance & Parajuli, 2014; Sitoe & Guedes, 2015).

Community based forest governance is a concept that opens new horizons and new spaces for communities to exercise political control over their territories and resources.

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Through horizontal decision-making mechanisms, it allows for community transparency and accountability. Even though the concept of good governance is abstract and almost impossible to achieve in its integrity, it is regarded as a crucial direction to achieve the goals of the country (UNESCAP, 2007). Different organizations have given different but somewhat similar indicators to assess the forest governance. In this study, the forest governance framework is given by FAO, 2011 will be used to assess the governance status of CF. The framework includes 3 pillars having 13 indicators altogether.

1.2 Rationale

Vulnerability to climate change is a function not just of biophysical outcomes related to variations and changes in temperature, precipitation, topography, and soil, but also of sociopolitical and institutional factors that can vary significantly at a relatively fine scale (Adger, 2006). Community forestry (CF) in Nepal is taken as a successful local institution in Nepal (Ojha et al., 2009). But research says, internal inequities in benefit sharing and decision making persist within many Community Forestry User Groups (CFUGs), which is the result of the local power imbalances. In addition, inadequate services have led to several new issues like good governance in CF all around the country (Bhatta & Gentle, 2004; Pokharel & Niraula, 2004; Upreti et al., 2004). According to Kanel 2004, "to meet the primary objective of CF, governance of the institutions has to be improved". Moreover, the establishment of good governance in CF is required for the sustainable forest management and improvement of people's livelihoods thus helping to reduce climatic vulnerability (Osmani, 2001). Whereas, poor governance might end up with ineffective climate adaptation practices thus increasing climatic vulnerability.

Most of the current work on adaptation has focused on technological and infrastructure for reducing vulnerabilities and enhancing adaptive capacity without giving much focus to one of the major pillars for effective adaptation i.e. institutions (Agrawal, 2008; Jones & Boyd, 2011). Thus, this study intends to explore the role of the good governance in maximizing the climate adaptation capacity of CFUGs. Moreover, this study also tends to find the facilitating and the constraining factors for the climate adaptation.

1.3 Research questions

The research question for this study will be:

- How has climate change trend and the impacted posed by it in Udipur?
- What is the status of the existing institutional set up of the community forestry of the study area?
- What is the nexus between good governance of local institutions and adaptive capacity?

1.4 Objectives

General objectives:

- To assess the climate change trend, its implications in Udipur and the role of the local institution (CF) in climate adaptations

Specific objectives:

- To analyze the trend of climate change, its implications and peoples understanding of it in the study area
- To assess the existing governance status of CFs of Udipur and their role in enhancing climate adaptations
- To assess the facilitating and the constraining factors for climate adaptation.

1.5 Limitations

The major limitations of this study are listed below:

(i)   The study was carried out in community forests of only one VDC (then) of one of the districts of our country.

(ii) Detail study of effectiveness of the adaptive measures and its relationship with the governance of the CF was lacking.

CHAPTER 2: LITERATURE REVIEW

2.1 Climate change trends

Climate change is not a new process rather it has been happening ever since the origin of Earth. But, after the beginning of industrial revolution, it has become more apparent that and the rate at which is it changing at present is faster than the normal phenomenon (IPCC, 2007). Temperature and precipitation are considered very important among few indicators of climate change (Shrestha et al., 1999). Studies have shown that these two of the major parameters are rapidly changing which is altering the livelihoods of the people along with their lifestyle patterns. A report of IPCC, 2007 showed the linear warming trend over the 50 years from 1956-2005 was 0.13°C per decade which is about twice than that for the 100 years from 1906-2005. This data can put the light that how rapid climate has been changing in recent times. Similarly, climate change has brought changes in rainfall pattern too. FAO (2014) showed that there are unpredictable weather patterns mostly during monsoon season, and it is seen that monsoon time has started getting shorter with heavy rainfall.

EC (2008) said at present, climate change is regarded as a serious challenge faced by all the living organisms in the world, and developing countries are more prone to the adversities of climate change. Nepal, considered as one of the most vulnerable countries to climate change, Climate Risk Index ranks Nepal in 19th position (Kreft et al., 2015). Many types of research and studies also support this statement. For example, a study carried out by NCVST (2009) concluded that the Nepal's mean annual temperature would increase by 1.4°C, 1.8°C, and 4.7°C, from the mean value between 1972 and 1999 in 2030, 2060 and 2090, respectively. Similarly, the records of the Department of Hydrology and Meteorology shows, during the period of 1975 to 2006, the average temperature was increased by 1.8°C per annum, this value is considered to be very high in comparison to many countries. Similarly, precipitation trend is also becoming unpredictable and erratic (in comparison with the past), with more droughts and intensified/heavy rainfall in a short period of time (Gurung, 2009).

2.2 Climate change impacts

The impacts of climate change have already been experienced throughout the country. It is both an environmental as well as a social problem in Nepal (Bhatta, 2011). Rural communities have been experiencing changes in temperature and rainfall patterns. The monsoon tends to begin later, the rainfall is more irregular and climate induced disasters

such as flash floods have been becoming more frequent (ADB 2009; Dixit et al., 2016). The winter rains have reduced and after some years, fail altogether and fall heavily any year. Many studies say people have been experiencing that summers are hotter and winters generally colder (Shrestha, 2009). Everyone gets affected by climate change but poor and marginalized people are bound to be affected more to a greater extent because of low economic status and limited livelihood options. This is one of the main reasons why developing countries that depend on natural resources are more prone to climate change and associated risks (Adger et al., 2003; Baker et al., 2012; Bharati et al., 2012; Gurung et al., 2013; Hua, 2009; IPCC, 2007). Hence, addressing the issues of climate change at the local level is a must thing to minimize the adversities of climate change (UNFCCC, 2009).

2.3 Climate change responses

The level of impacts is casually coherent and correlated to the natural response we do to minimize its impacts. Action based approaches would help avoid threatened environmental situations and risks cause by climate change (UNFCCC, 2007). Globally, mitigation (reduction of greenhouse gas emissions and an increase of carbon sequestration) and adaptation (ways of reducing the impacts of, and vulnerability to, climate change) are two major practices that have been under action to address the climate change issues. For the country like Nepal which is facing immense impacts of climate change, adaptation to the climate change is found to more important than mitigation for now. Climate hazard is taking the life and property of many people in Nepal every year, which is because of poor adaptation capabilities, thus to decrease the risk from the hazard, adaptation should be done first. IPCC (2001) has also found that adaptation is a must approach for reducing vulnerability to climate change.

Adaptation is a broad term that incorporates vulnerability to climate change risks and adaptive capacity of the system to adjustment (Rodledo et al., 2005). A number of typologies have been developed to classify adaptation activities which are based on timing (anticipatory vs. reactive), scope (short term vs. long term; localized vs. regional), purposefulness of adaptation (spontaneous vs. planned) and adapting agent (private vs. public) (Agrawala et al., 2008). There have been many classifications of adaptation; however, most of the literature classify adaptation as:

Autonomous (spontaneous adaptation) or planned adaptation: adaptation by households and communities acting singly handily without public-policy interventions but within an

existing public-policy framework is an autonomous adaptation. While adaptation that is the result of a measured policy decision is the planned adaptation (Margulis et al., 2008). Proactive (anticipatory) and reactive (ex-post): Proactive adaptation is the adaptation that takes place before facing the impact of climate change, while, adaptation practices after the impacts of climate change have been felt is known as the reactive adaptation (Margulis et al., 2008).

2.4 Community based adaptation

Among many adaptation practices taking place around the world, the Community Based Adaptation (CBA) practices seem to be one of the most effective adaptation practices (UNFCCC, 2007). Ideally, CBA is a community-led and driven adaptation practice done by the community themselves (Kirkby et al., 2016). This approach considers that adaptation strategies must be generated through participatory processes, involving local stakeholders and development and disaster risk–reduction practitioners and is not limited to science based inputs only (Ayers et al., 2009). The primary aim of CBA is to support the adaptation needs of the most vulnerable, poor and marginalized peoples living in high-risk environments, primarily in developing countries (Kirkby et al., 2016).

To address climate change impacts, Nepal has also implemented many adaptation practices, NCCSP program of government is one of the successful programs under action. (MOSTE/NCCSP, 2015). The program aided in contribution to the poorest and most vulnerable communities to help adapt to the impacts of climate change. Besides this other effective community based adaptation in Nepal is community forestry programs.

2.5 Role of local institutions in adaptation

Institutions are formal and informal rules that shape social structures through the decision-making process and collective action approach (Agrawal et al., 2008). It is categorized into formal and informal institutions. Formal institutions are openly codified, in the sense that they are established and communicated through channels that are widely accepted as official whereas informal institutions are socially shared rules, usually unwritten, that are created, communicated, and enforced outside of officially sanctioned channels (Helmke and Levitsky, 2004). The major difference between them is informal institutions are not laid down in writing and tend to be more persistent than formal rules. Institutions can further be classified as falling into public (bureaucratic administrative units, and elected local governments), civic (membership and cooperative organizations), and private sectors (service and business organizations) (Uphoff & Buck, 2007).

The study of institutional governance comes from the literature on common property and natural resource governance (Agrawal, 2008; Dressler et al., 2010; Gibson et al., 2000; Ostrom, 1990). Climate change literature suggests that institutions (both formal and informal institutions) are a crucial element for adaptation as govern and regulate key assets needed to adapt to climate change (Agrawal 2008; Jones & Boyd, 2011; Koch et al., 2007; Regmi et al., 2013; Smit & Pilifosova, 2007). This study considers community forestry as a local institution.

2.6 Community as a local institution

In Nepal, community forestry is one of the local intuitions which is shaping up the livelihood as well as in the protection from different disasters and climate change impacts (Bk, 2010). Climate Change Policy, 2011 has also identified community organizations, including community forest user groups as local units of planning and implementation of adaptation activities. Community forestry is one of the successful programs to decentralize forest resource management all around the world, including Nepal (Ojha et al., 2009). The user group residing in CF are entitled Community Forestry User Groups (CFUGs). CFUGs of Nepal are self-regulated, autonomous institution in the rural area. It is considered to be strong because of its legal status, coverage, leadership, resources available and linkages with other agencies (Kanel & Kanel, 2004; Ojha et al. et al.,, 2009). The community forestry in Nepal has proven to be a learning ground for good governance in reference with participatory decision-making, bottom-up planning process, gender, and equity sensitivity, partnership among government, non-government and private sector agencies, participatory monitoring and evaluation mechanism (Pokharel and Niraula, 2004).

But, in recent times, the local institutions are facing the challenge of fair governance; around the structure and composition of the institutions, decision making processes and outcomes, responsiveness to all voices of the society and accountability to the people (Adger & Vincent, 2005). Regmi et al. (2016), claimed that the exclusion of poor, women and disadvantaged groups in adaptation decision-making is influenced by the institutional environment such as the social and cultural context of Nepal.

According to studies, good governance plays a great role in community forestry management thereby contributing to reduction of climate vulnerability (Bisaro & Hinkel, 2016). The term 'governance' has its roots to different concepts and definitions, hence, this widely used term is understood in many ways. (UNDP, 2002) defines governance as

the complex of mechanism, processes, relationships, and institutions through which citizens and groups articulate their interest, exercise their rights and obligations and mediate their differences. Governance is considered as a neutral term, and good governance is usually that, whose attributes are in accordance with the principles of governance (Gurung, 2002). Good governance is often related with principles like transparency, participation, and accountability (Davis et al., 2013). Governance can be used in several contexts such as corporate governance, international governance, national governance and local governance (UNESCAP, 2009). People's participation, accountability, transparency and pro poor policy change are considered as important dimensions of governance in forest resources management (Dahal, 2003). Good governance follows its principles (Gurung, 2002). The concept of good governance is still a theoretical matter with low chances of fully being accomplished, good governance still plays a major role in achieving many goals (UNESCAP, 2009). Good governance in the foundation of CF is required for the sustainable forest management and improvement of people's livelihoods thus helping to reduce climatic vulnerability (Osmani, 2004).

At present, the absence of inclusive policy making process and pro-poor policy outcomes, lack of adaptive organizational structure and bottom-up planning, and inequitable decision making and benefit distribution systems are the some of the governance related issues of CF (Pokharel & Niraula, 2004; Upreti et al., 2004).

Different organizations like World Bank, FAO, UNESCAP have come up with different indicators for governance but the essence of all have remained the same. Several types of research have been using differents framework for the assessment of the status of the governance and challenges faced by the institutions. (Lamichhance & Parajuli, 2014) have taken the governance indicators set by UNESCAP's eight criteria of good governance into account (Nepal, 2007) used common indicators of governance. But, this study uses the forest governance framework given by FAO, 2011.

CHAPTER 3: MATERIALS AND METHODS

3.1 Study area

The study focused of Udipur Village Development Committee (VDC) of Lamjung district. Lamjung district is located in the Gandaki zone of the Western Development Region of Nepal. It borders with others districts like Gorkha in East, Kaski in West, Manang in North and Tanahun in South. The district lies in Latitude of 28º03'19" to 28º30'38" N and Longitude of 84º11'23" to 84º38'10" E. It is one of the districts that lie in the mid-hills of Nepal covering an area of 1692 sq.km with an altitude range from 385 m to 8162 m. The total population of the district is 167,724 (CBS, 2011). It comprises a total of 42,079 HHs with an average size of 3.99. Based on ethnicity, Janajati is the dominant caste comprising about half of the population followed by Brahmin/Chhetri and Dalit.

The district shows 5 climatic zones: Tropical climate (up to 1000 m), Sub-tropical climate (1000-2000 m), Temperate cold climate (2000-3000 m), Sub-Alpine climate (3000-4000 m), and Alpine & Tundra climate (above 4000 m) (DFO, 2012). The annual mean temperature is recorded at 14.1-26.7ºC and the annual precipitation as 2944.23 mm. Forest is the dominant land use covering 40% of total land, that is followed by cultivated land and grazing land comprising respectively 27% and 15 % (DFSP, 2013-2018). The total cultivated area is recorded as 45,050 ha while 14,465 ha area remains agricultural practices. The district is rich in water resources and there exist 13 major rivers and streams (District Profile of Lamjung, 2000).

The specific study area (Udipur) for this research also lies in Lamjung district. Udipur lies towards the lower center part of Lamjung district. Udipur used to be a VDC but this has been recently added into the Besisahar Municipality. Lamjung is one of the districts of mid hills of Nepal which is rich in community forestry. As per 2016 community forestry bulletin of Nepal, it has 304 CFUGs including 24,825 households. The community forest of Lamjung covers an area of 19,334 Ha. Whereas, there are seven community forests in Udipur comprising a total of 574 HHs (DoF, 2017) (Table 1). All community forest of the Udipur was studied. The map in Figure 1 shows the study area in details.
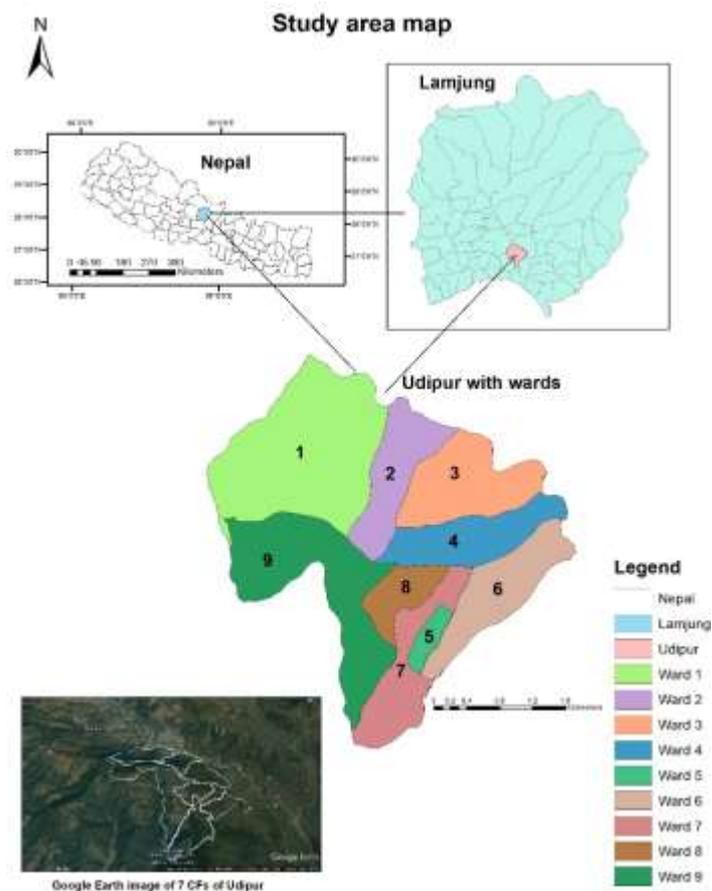
Figure 1: Study area map

The details of the community forests of Udipur is highlighted in Table 1.

Table 1: Details of CFs of Udipur, Lamjung (DoF, 2017)

SN	VDC/Ward No.	CFUG Name	Operational Plan approval date	CF Area (ha)	HH number	Committee member	OP revised
1	Udipur 1	Patalepani	11th Jul, 2001	88.54	94	11	1st Jan, 2008
2	Udipur 1,2	Mandali	6th Mar, 1997	125.43	103	11	7th Jul, 2008
3	Udipur 3,4	Kalika	1st Apr, 1996	63.24	141	15	1st Jan, 2008
4	Udipur 5,6	Bankali	26th May, 1996	20.43	91	11	10th Jun, 2009
5	Udipur 7	Gyadipakha	2nd Jan, 1996	60.67	59	11	11th Jul, 2001
6	Udipur 8	Manaki danda	2nd Jan, 1996	70.48	53	9	5th Jul, 2006
7	Udipur 9	Jwaladevi	2nd Jan, 1996	60.67	59	11	11th Jul, 2001

3.2 Methods

Both primary and secondary data were collected in this study. The primary data were collected by Household survey, Key Informant Interview (KII), Focus Group Discussions (FGD). Whereas, secondary data were collected by the review of different

journal paper, governmental and non-governmental organizations report, news articles. This study was based on both qualitative and quantitative sets of data. CFUGs was taken as local institutions that are working directly on climate change adaptation. There are seven CFUGs in Udipur, all CFUGs were studied to increase the robustness of data. The study was based on the case study approach as it is considered as an established research method to understand the complex social phenomenon in social science (Yin, 2009). The detailed method is discussed below.

3.2.1 Primary data collection

3.2.1.1 Schedule survey

For household survey, first, the sample size of the universe of seven community forests of Udipur was calculated by using the formula given by Krejcie and Morgan (1970), then stratified random sampling method was used for the collection of the data. Community forest was taken as strata. Scheduled survey technique was used for data collection. HHs survey was done with a set of questions giving an idea on socioeconomic attributes, knowledge on climate change, adaptation measures were taken, institutions functioning and local governance status.

3.2.1.2 Key Informant Interview (KII)

In order to get adequate information, key informant interview was also conducted. The people involved in climate change adaptation activities, scholars, senior citizens, the social worker was regarded as the key informant. Thus, they were purposively chosen for the study. Altogether 10 KII was done from seven CFUG of Udipur, ensuring 1 from each CF and rest 3 people outside of CF (DFO, NGO officer, expert). Key informant interview helped to understand the effectiveness of local institutions in improving or decreasing the adaptive capacity of the CFUGs.

3.2.1.3 Focus group discussion (FGD)

Focus group discussion was also done for data collection. It was done ensuring the proper representation of the people involved in an active local group like CFUGs, women's groups, youth club, local political leaders, social workers and others. FGDs helped us to understand the effectiveness of the local institutions as well as the challenges faced by them during adaptation process to reduce climatic risk. FGD was focused on the topic like institutions mapping, climate risk mapping and institutions adaptive matrix. Seven FGDs were done in seven CFs of Udipur.

3.2.1.4 Field observation

A Field observation was carried out to validate the information different sources of information such as schedule survey, focus group discussions and key informant interviews.

3.2.2 Secondary data collection

Along with the primary data, secondary data from various sources was used to increase the robustness of the collected data. The sources of the secondary data were journal papers, governmental and non-governmental reports, news articles and others. Data regarding the climate change trend, its impacts, governance and its role adaptation activities were collected.

3.2.3 Sample size calculation and sampling design

For sample size calculations formula of Krejcie and Morgan (1970) was used (eq. 1). A total of 574 HHs were present in Udipur and the sample size was 230 HHs.

$$S = \frac{X^2 \, NP \, (1-P)}{d^2 \, (N-1) + X^2 \, P(1-P)} \quad \text{------------------------------- (eq. 1)}$$

Where,

S = Required Sample size

X = Z value (e.g. 1.96 for 95% confidence level)

N = Population Size

P = Population proportion (expressed as decimal) (assumed to be 0.5 (50%)

d = Degree of accuracy (5%), expressed as a proportion (.05); It is the margin of error

3.2.4 Research Design
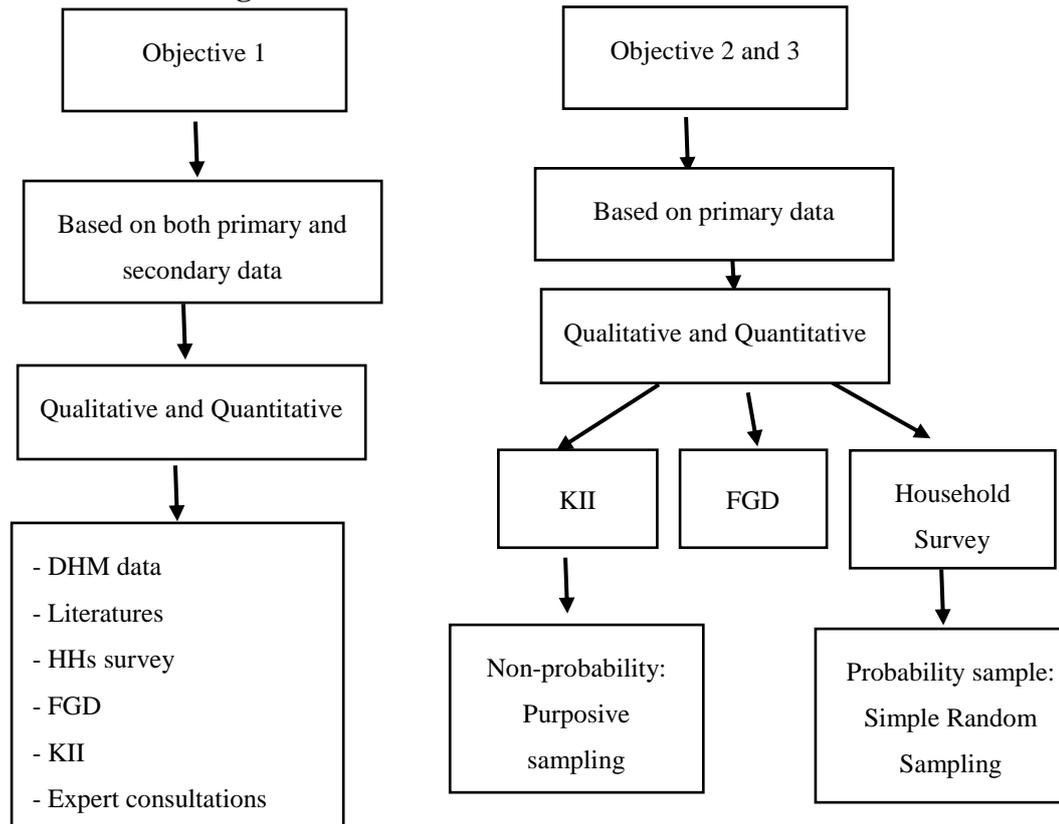
Figure 2: Sampling Design

3.4 Data analysis

Data were analyzed both qualitatively and quantitatively. All the data collected were further tabulated and analyzed using different statistical tools like Microsoft excel 2016, XLSTAS, Statistical Package for Social Science (SPSS) version 20, and qualitative data analyzing software called NVivo 11.

Climatic data were analyzed by the use of the software called XLSTAS. Mann Kendall test was performed for those data which were not found to be normal whereas linear trend line was drawn to find the trend of the temperature and precipitation of the normal data. To find the governance status of the community forest, 3 pillars having 13 indicators of forest governance given by (FAO, 2011) (Table 2) was used and further analyzed.

Table 2: Indicators of forest governance given by FAO, 2011

Pillar 1: Policy, legal, institutional and regulatory frameworks	
1.1	Forest-related policies and laws
1.2	Legal framework to support and protect land tenure, ownership, and use rights
1.3	Concordance of broader development policies with forest policies
1.4	Institutional frameworks

1.5	Financial incentives, economic instruments, and benefit sharing
Pillar 2: Planning and decision-making processes	
2.1	Stakeholder participation
2.2	Transparency and accountability
2.3	Stakeholder capacity and action
Pillar 3: Implementation, enforcement and compliance	
3.1	Administration of forest resources
3.2	Forest law enforcement
3.3	Administration of land tenure and property rights
3.4	Cooperation and coordination
3.5	Measures to address corruption

Pillar 1: Policy, legal, institutional and regulatory frameworks – This considers long-term systems of policies, laws, rules, and regulations within the forest sector and in other sectors that impinge on forests. This pillar focuses on forest use, management, and forest-related decision-making.

Pillar 2: Planning and decision-making processes – This pillar considers the degree of transparency, accountability, and inclusiveness of key forest governance processes and institutions.

Pillar 3: Implementation, enforcement, and compliance – It examines the extent to which the policy, legal, institutional and regulatory frameworks are implemented. It further considers the level effectiveness, efficiency, and equitability.

Accountability, Effectiveness, Efficient, Fairness/Equity, Participation, Transparency are the driving factors for the three pillars (Figure 3).
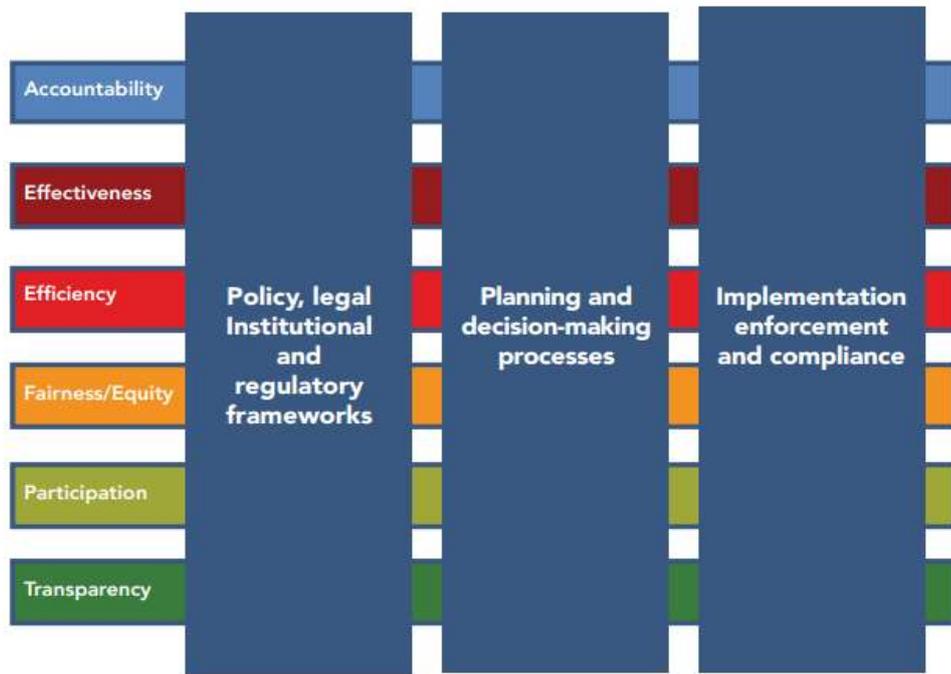
Figure 3: Pillars and principles of governance (Source: FAO, 2011)

Moreover, to convert qualitative information into quantitative score was given for each indicator in the form very poor= 1, poor= 2, fair=3, good= 4, very good= 5. Moreover, a mathematical approach similar to (Lamichhance & Parajuli, 2014) was applied to find out the governance status of each CF of Udipur.

i) The response of respondents for each pillar = $\dfrac{\text{Sum of scores in each pillar}}{\text{Number of indicators}}$

ii) Status of each pillar (%) = $\dfrac{(\text{The response of respondents for each pillar} \times 100)}{(\text{expected value} \times \text{number of respondents})}$

iii) Status of governance in each CFUG (%) = $\dfrac{(\text{the sum of the status of each pillar (\%)})}{(\text{number of pillars})}$

Thereafter, a category for the governance based on the status of the governance in percentage was calculated. Since there is no defined theory to categorize the status of governance, a approach was developed (Table 3).

Table 3: Categorizing the forest governance

Governance status (%)	Category
0-20	Very poor
21-40	Poor
41-60	Fair
61-80	Good
81-100	Very good

The governance status was further analyzed to find the relation of the status of the governance of the CF with the number of climate adaptation activities performed by them. It was done by the use of SPSS using Karl Pearson correlation coefficient. Similarly, qualitative data analysis NVivo 11 was used. The data from the FGD and KII was managed and analyzed through NVivo 11. It was mostly used for the objective 2nd and 3rd. Some of the data from NVivo was further changed into quantitative form and was analyzed statistically using Karl Pearson correlation coefficient.

CHAPTER 4: RESULTS

4.1 Socioeconomic context

In seven CFs of Udipur, 230 Households (HHs) were surveyed to collect the socioeconomic information. The analysis of that data shows the following information.

4.1.1 Demographic information

Among 230 HHs respondents, 121 (52.6%) were male and rest 109 (47.4%) were female. This shows the balanced proportion of the male and female population in collected data. Similarly, age-wise classification showed that 29 (12.8%), 82 (36.1%), 68 (30%), and 48 (21.1%) of the respondent belong to the age group of 13-25 years, 26-50 years, 51-60 years and 60+ respectively as shown in Figure 4. The education level of the respondent was also documented. Moreover, the data shows that 75 (34.4%), 38 (17.4%), 59 (27.1%), 30 (13.8%), 14 (6.4%), 2 (0.9%) people were illiterate, literate (able to sign), read less than class five, SLC graduate, +2 level, and degree level. No respondent was found to be reading on graduate level. The analysis of the level of education of the respondent showed that 172 out of 230 (which more than 79% of the participants) have not completed SLC level.
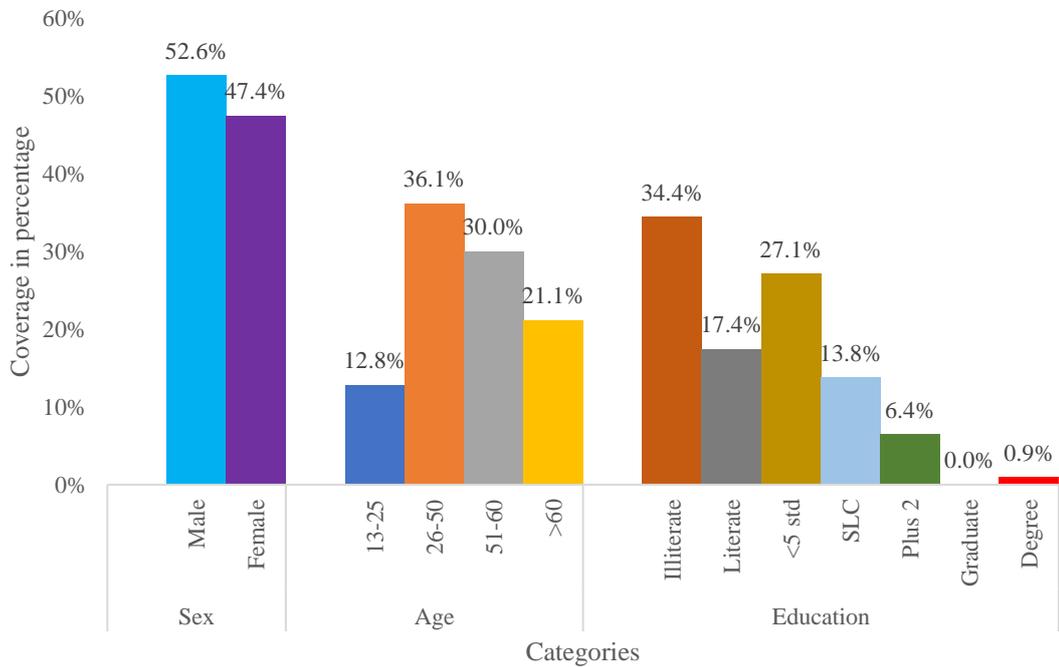
Figure 4: Demographic information of the respondents

4.1.2 Religious and ethnic profile

The Cultural and demographic information showed that most of the people belong to the caste Bhramin/Chhetri caste and followed Hinduism religion (Figure 5). More

specifically, 117 (57.6%), 21 (10.3%), 38 (18.7%),11 (5.4%), and 16 (6.6%) people belong to the caste of Bhramin/Chhetri, Newar, Janajati (Gurung and Magar mostly), Sarki and others. The people that feel in others group were mostly Kami, Damai. District data says Janajati people have dominance in Lamjung with 32.17% of the total population of the district represented by Janajati. But, in Udipur, most of the respondent was found to belonging to Brahmin/Chhetri culture while Janajati fell the third ranked caste according to the population of Udipur.

Similarly, as shown in Figure 5, 197 (90%), 21(9.6%) and 1 (0.5%) belonged to the Hindu, Buddhist and Christian religion. People of Muslim and other religion weren't found among the 230 respondents. This shows that maximum people of Udipur were following Hinduism.
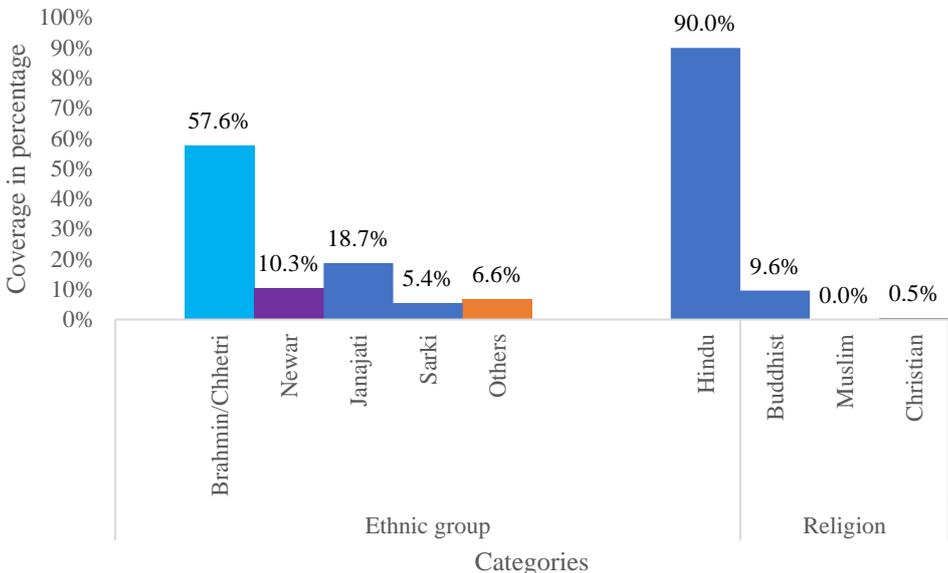
Figure 5: Ethnicity and religion of the respondents

4.2.3 Economic information

When asked about the source of income 122 (55.2%), 15 (6.2%), 16 (7.2%), 32 (14.5%), 36 (16.3%) of the respondent said that their primary source of income was farming (agriculture), wedge labour, local business, service, and remittance respectively. Similarly, 73 (56.6%), 18 (14%), 5 (3.9%), 18 (14%), 15 (11.6%) of the respondent said that their secondary source of income was Farming (agriculture), wedge labour, local business, service, and remittance respectively (Figure 6).

Information about the primary and secondary occupation of the respondent showed that a maximum number of the people of Udipur had Farming as the primary occupation. And those whose primary occupation wasn't farming, most of their secondary occupation was found to be farming. Thus, it can be said that maximum people of Udipur are dependent upon agriculture to sustain their livelihood.

Calculations of monthly expenses of HHs found that, 20 (9.2%), 71 (32.7%), 62 (28.6%), 35 (16.1%), 13 (6%), 16 (7.4%) of HHs have average monthly expense of <5000, 5000-10000, 10000-15000, 15000-20000, 20000-25000 and >25000 respectively. More than 77% of the HHs had the monthly expenses between 10000-20000.
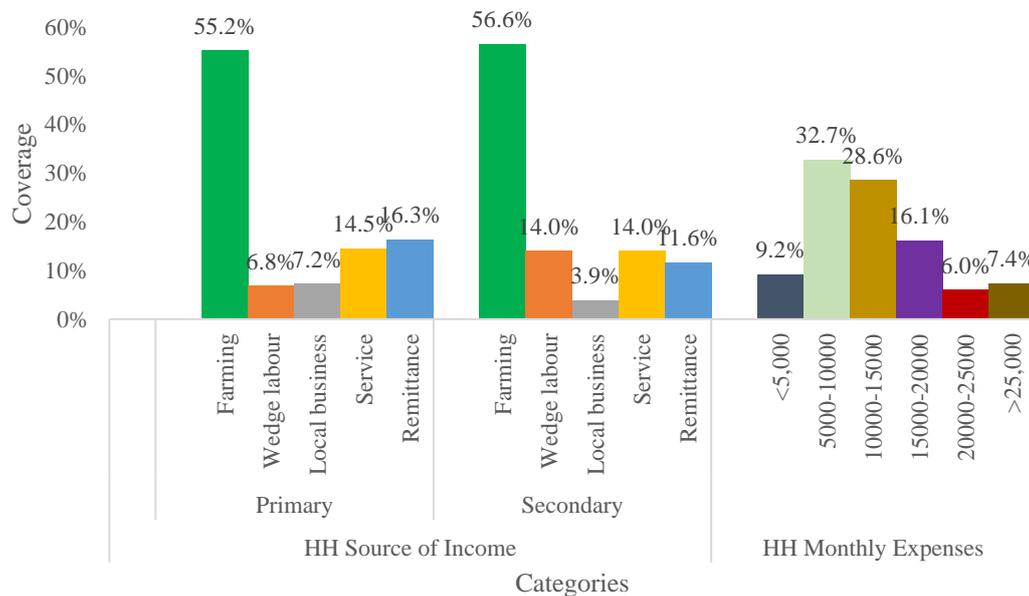
Figure 6: Economic settings of the respondents

4.2 Precipitation and temperature trend and people's perception

4.2.1 Precipitation trend and people's perception

Analysis of 35 years precipitation data from Department of Hydrology and Meteorology from the year 1980-2015 shows that there is no trend in the precipitation. (Figure 7) showed that the precipitation doesn't seem to have fix trend in any years. The maximum yearly precipitation was seen in the 4484 mm in 1996 while the minimum precipitation was 2070.3 mm in 2014. The 35 years precipitation data of Khudibazar station of Lamjung shows that there is a huge difference in the yearly maximum and minimum annual precipitation.

Adding to this, the perceptions of the people seems to be matching with the trend of the precipitation. Among 230 respondents, 57.27% of them said that the precipitation pattern seems to be uneven (Figure 7). Meanwhile, only a few percentage of people said the

precipitation pattern in on increasing or decreasing trend. 15.41% of respondent said the precipitation was increasing while 18.06% of respondent said the precipitation pattern was decreasing.
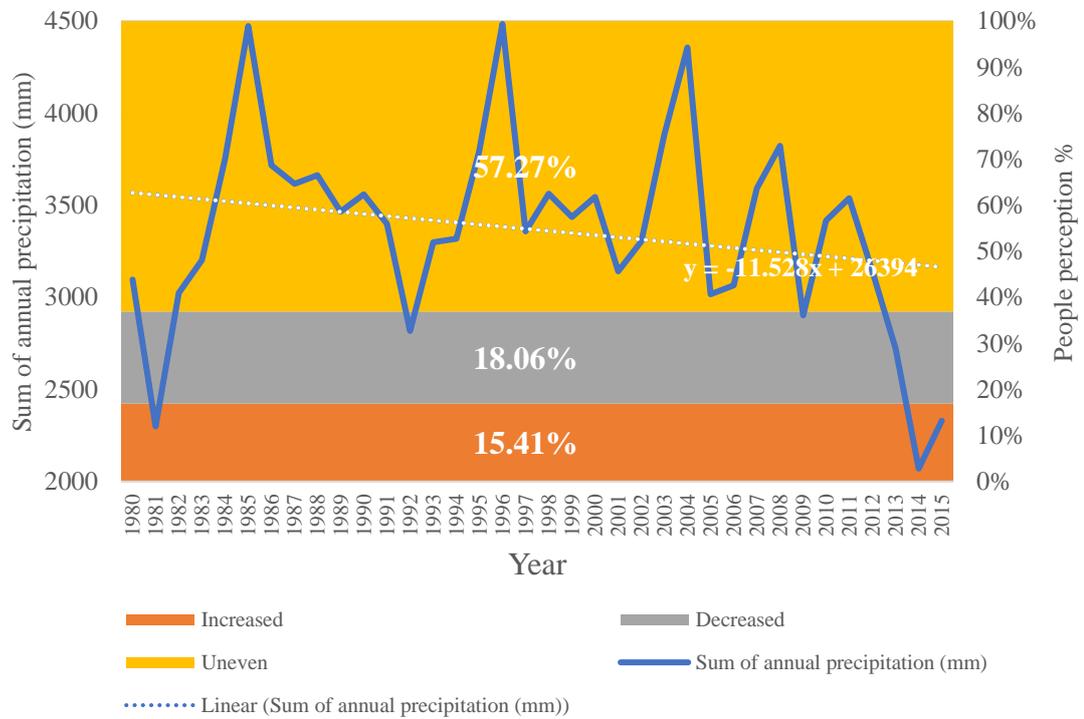
Figure 7: Yearly precipitation trend and people's perception

4.2.2 Temperature trend and people's perception

Yearly temperature trend from the year 1980-2015 of the Khudibazar station of Lamjung was also analyzed. Both seasonal temperature of summer and winter were analyzed. Similarly, to assess the people perception about the temperature trend views of people were also collected.
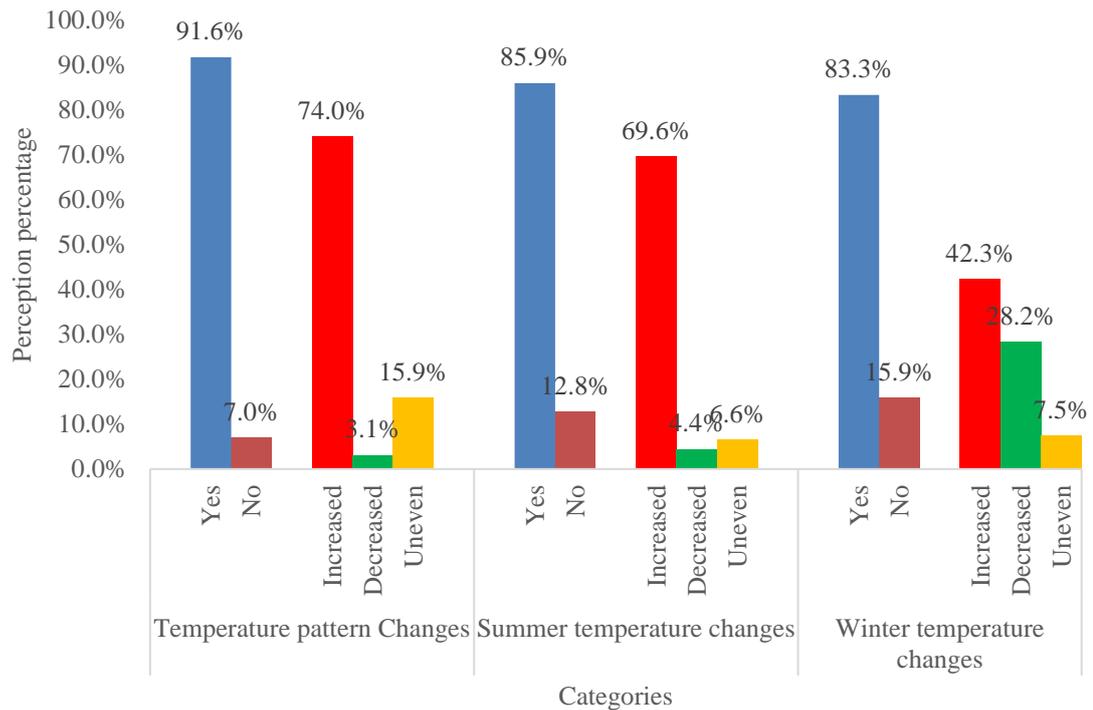
Figure 8: People's perception towards temperature trend

4.2.1.1 Summer temperature trend and people's perception

The analysis of the 35 years of summer temperature trend shows there is some trend for Khudibazar station. After fixing all the missing data Mann Kendall test was applied and to analyze the trend in the summer temperature of Khudibazar. The test showed that yearly average summer temperature was on increasing trend. The test further showed that on average the summer temperature of that region has been increasing by 0.043°C per year (Table 4).

Similarly, when the analysis of people perception showed that 91.6% of the respondent said that they have felt the change in the temperature pattern over the years. More specifically, 74% of the respondent said the yearly temperature has been increasing over the years while 15.9% of them said the yearly temperature pattern has been uneven (Figure 8). Meanwhile, when people were asked about the change in the summer temperature, 69.6% said that they have witnessed an increase in summer temperature. Thus, both the DHM data and people's perception seems matching with each other.
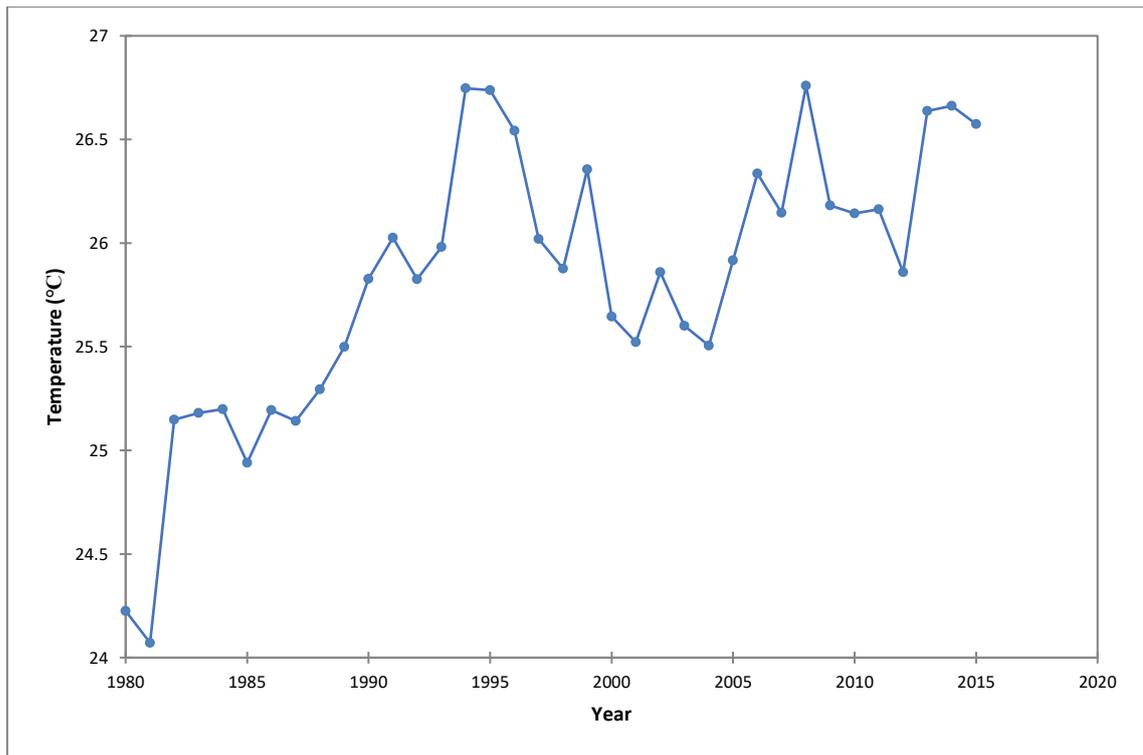
Figure 9: Yearly summer temperature trend of Khudibazar station

Table 4: Mann Kendall test values for Summer temperature

p-value (Two-tailed)	< 0.0001
Alpha	0.05
Sen's slope	0.043

4.2.1.2 Winter temperature trend and people's perception

From the observation, winter temperature trend of Khudibazar station from the year showed 1980-2015 average yearly winter temperature was observed to be increasing by 0.05°C on average (Table 5).

Meanwhile, the analysis of the perception of the people on minimum yearly average temperature (Figure 8) showed that 83.3% of the respondent believes that there has been a change in the pattern of the winter temperature. Among the respondents who said winter temperature has been changing, 42.3% of them said the winter temperature is increasing while 28.2% of the people who believe there has been in the average yearly average temperature said that the winter temperature is decreasing and thus being colder than it used to be. Rest 7.5% of the respondent said that the winter temperature pattern has been uneven.
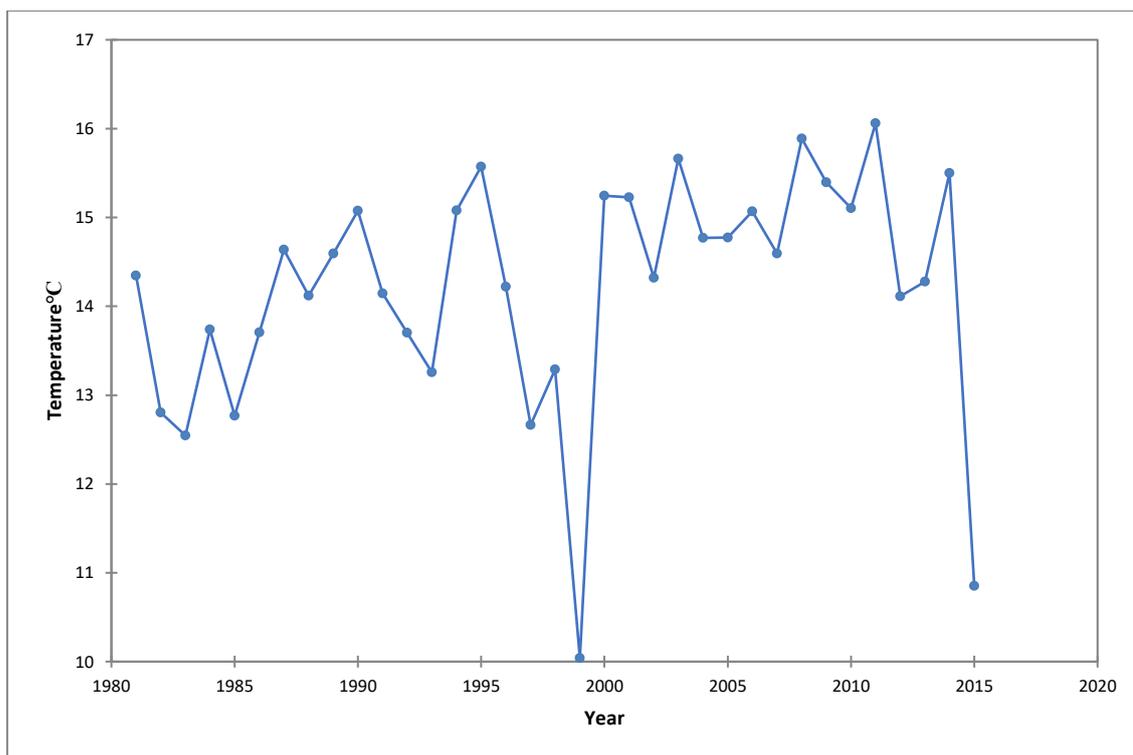
Figure 10: Yearly winter temperature trend of Khudibazar station

Table 5: Mann Kendall test values for winter temperature

p-value (Two-tailed)	0.001
Alpha	0.05
Sen's slope	0.05

Analyzing both, yearly average minimum and maximum temperature showed that, the both summer and winter temperature are on increasing trend. Whereas, the average yearly winter temperature has been increasing in much rapid pace than that of average yearly summer temperature.

4.2.3 Climate induced impacts faced by the locals

Among 11 major climate induced impacts, the frequency of almost all the impacts were found to be increasing in recent times. The study found that according to the local people invasion, decline in crop productivity, change in cropping calendar, pest attack was increasing highly (Figure 11).
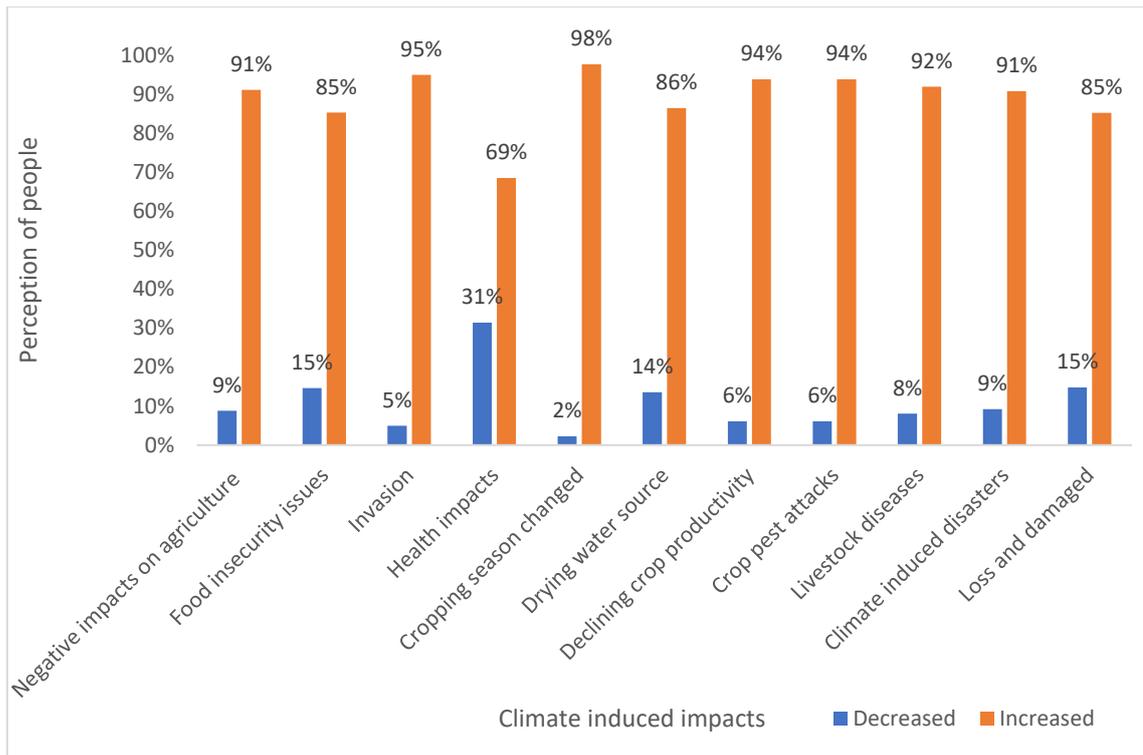
Figure 11: Change in the frequency of the climate induced impacts

4.3 Status of governance of Community Forests of Udipur

4.3.1 Institutional governance of Patalepani CF

To assess the governance status of the Patalepani community forest, 38 HHs were surveyed. The analysis of the data showed that among 13 forest governance indicators given by FAO, 2011 (Table 2), 9 indicators were found to function well but remaining 4 indicators seems to be creating a problem for making the governance improved in the Patalepani CF. Four of them includes (i) Forest-related policies and laws (ii) Transparency and accountability (iii) Cooperation and coordination (iv) Measures to address corruption. The weakest of them was found out to be cooperation and coordination, as about 50% of the respondent said it was functionally poor or very poorly in Patalepani CF whereas the strongest governance indicator of Patalepani CF was found out to be Administration of land tenure and property rights, about 87% of the respondent said that it was functioning well or very good. Meanwhile, the overall governance of Patalepani was 64.74% which falls in the good category.
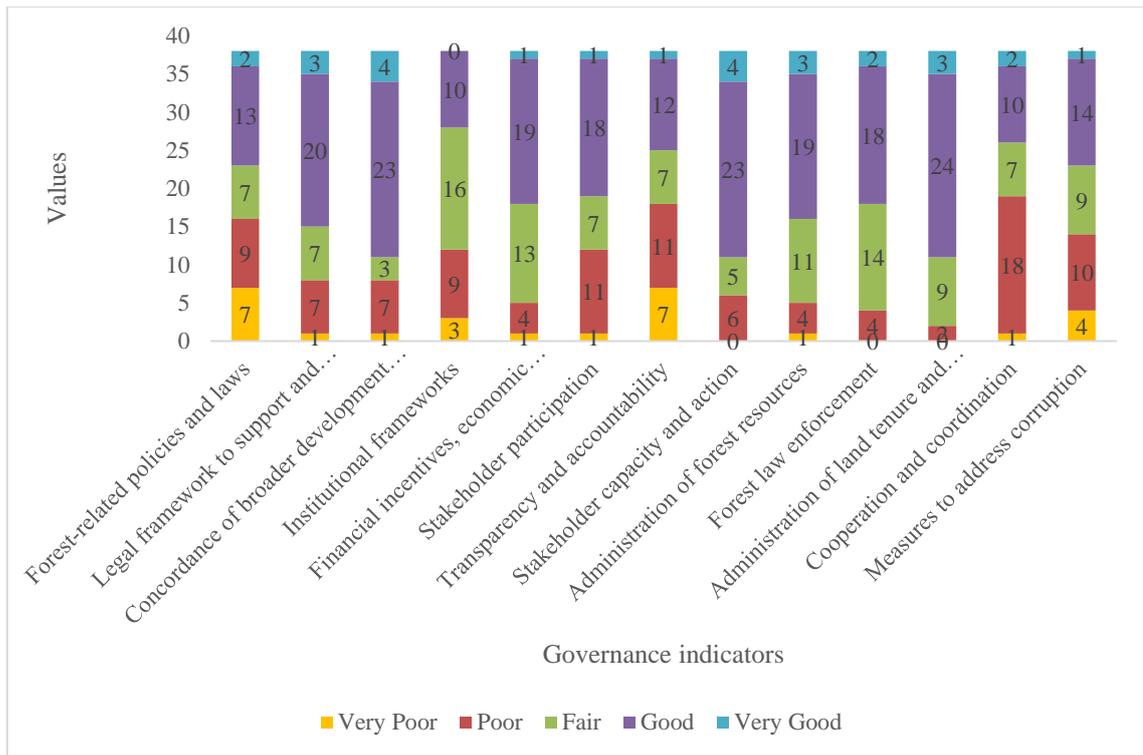
Figure 12: Status of different governance indicator of Patalepani CF

4.3.2 Institutional governance of Mandali CF

The analysis of the responses from 41 HHs from Mandali CF showed that out of 13 governance indicators given by FAO, 2011, many indicators fell in the category of fair and good. The major 4 weakest indicators in Mandali CF includes (i) Forest-related policies and laws (ii) Transparency and accountability (iii) Administration of land tenure and property rights (iv) Measures to address corruption. In comparison to these 4, rest 9 were found to be functioning better.

Similarly, the overall governance status of Mandali CF was found to be 65.78% which falls in the good category.
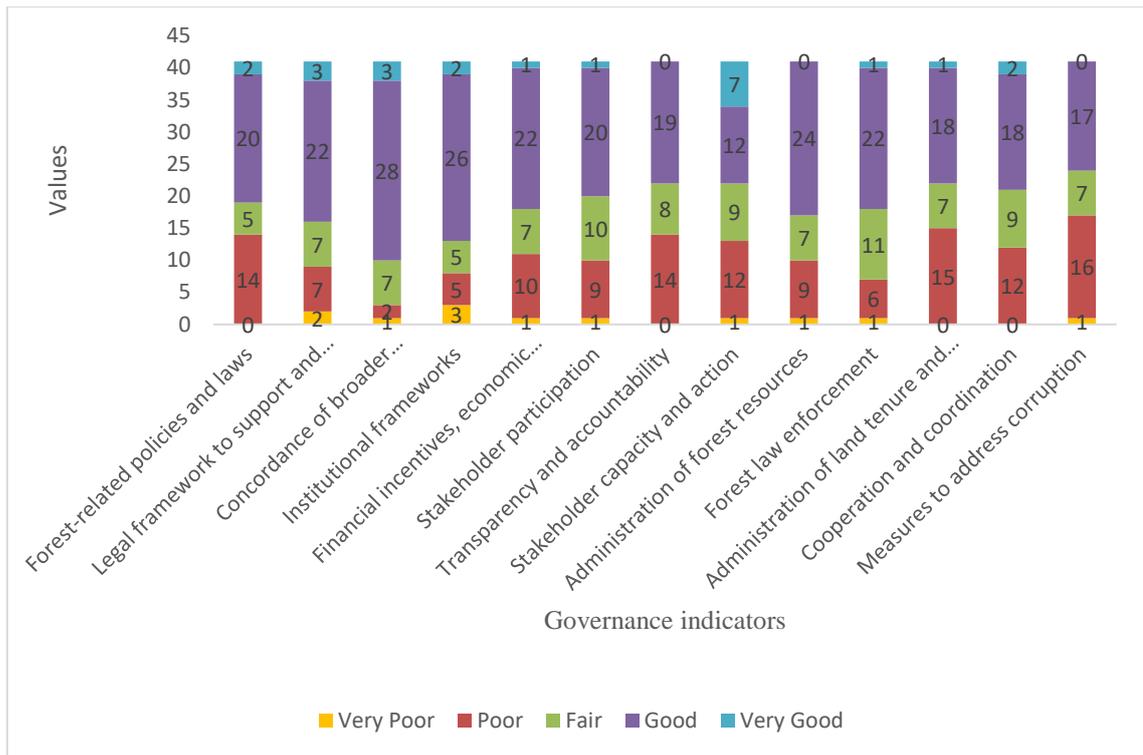
Figure 13: Status of different governance indicator of Mandali CF

4.3.3 Institutional governance of Kalika CF

Kalika CF was found to have better governance status in comparison to all rest all CF of Udipur, Lamjung. Kalika seems to have very few weak indicators when talking about the forest governance. 56 respondents (CFUG members) were randomly selected for data collection. The analysis of the data showed that the overall governance status of this CF was found to be 79.32% (Figure 14) which is the highest of among all CF of Udipur. Most of the governance indicators seem to work fine but when we have to rank lower three indicators, it would have been (i) Forest-related policies and laws (12%) (ii) Financial incentives, economic instruments and benefit sharing (14%) (iii) Stakeholder capacity and action (20%) (Figure 14). However, these three indicators were not that lowest as compared to another CF. Only 12%, 14% and 20% of the respondents said those listed there were the weakest forest governance indicators of Kalika CF.

All as a whole, Kalika CF was found out to have the best governance as compared to other 6 CFs of Udipur.
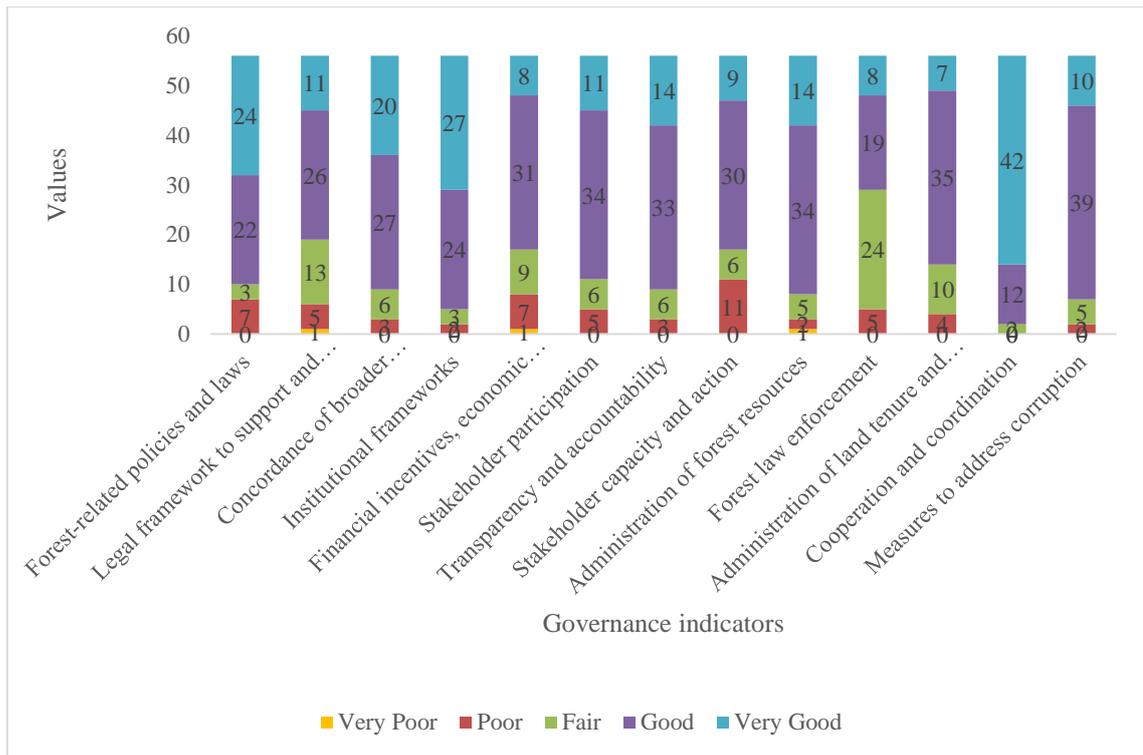
Figure 14: Status of different governance indicator of Kalika CF

4.3.4 Institutional governance of Bankali CF

The overall forest governance of Bankali was found out to be 64.73% which also fall in the good category. Among 13 good governance indicators, 9 of them were found out to be in the fair and good category. But, Bankali CF seemed to have to problem in some of the indicators of forest governance. Few indicators seem to be overlooked as compared to other. Among the weakest indicator of Bankali CF major four includes (i) Forest-related policies and laws (ii) Transparency and accountability (iii) Forest law enforcement (iv) Measures to address corruption. 36 respondents from Bankali CF 50%, 38.9%, 38.9% and 47.2% respectively said above listed 4 indicators are functioning poorly or very poorly in Bankali CF.
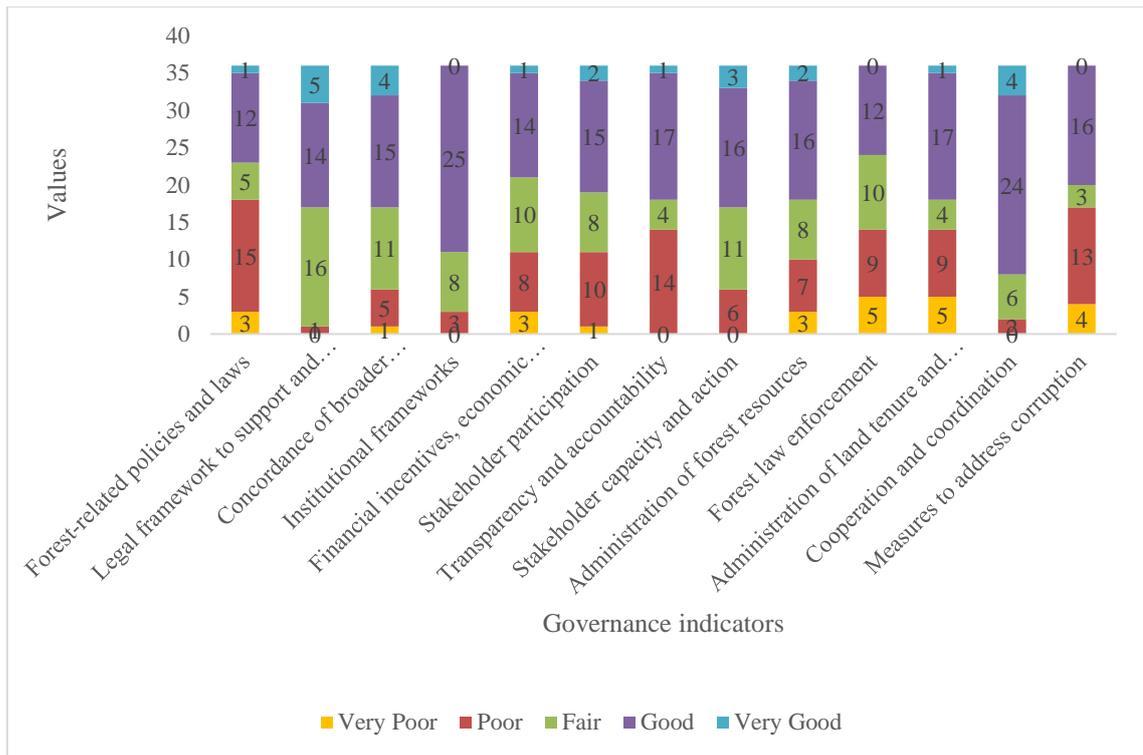
Figure 15: Status of different governance indicator of Bankali CF

4.3.5 Institutional governance of Gyadipakha CF

24 respondents (CFUG member) of Gyadipakha CF was randomly selected to assess the forest governance status. The analysis of the data found that the overall governance status of this CF was 62.69% which falls in the good category. Gyadipakha had mixed type of governance status when talking about particular indicators. Few indicators were good while many of them were fair and some of them were poor. Transparency and accountability were found to be best among the 13 forest governance indicators. Whereas, 4 among 13 indicators which were found to be weak were (i) Stakeholder capacity and action (ii) Administration of forest resources (iii) Cooperation and coordination (iv) Measures to address corruption.
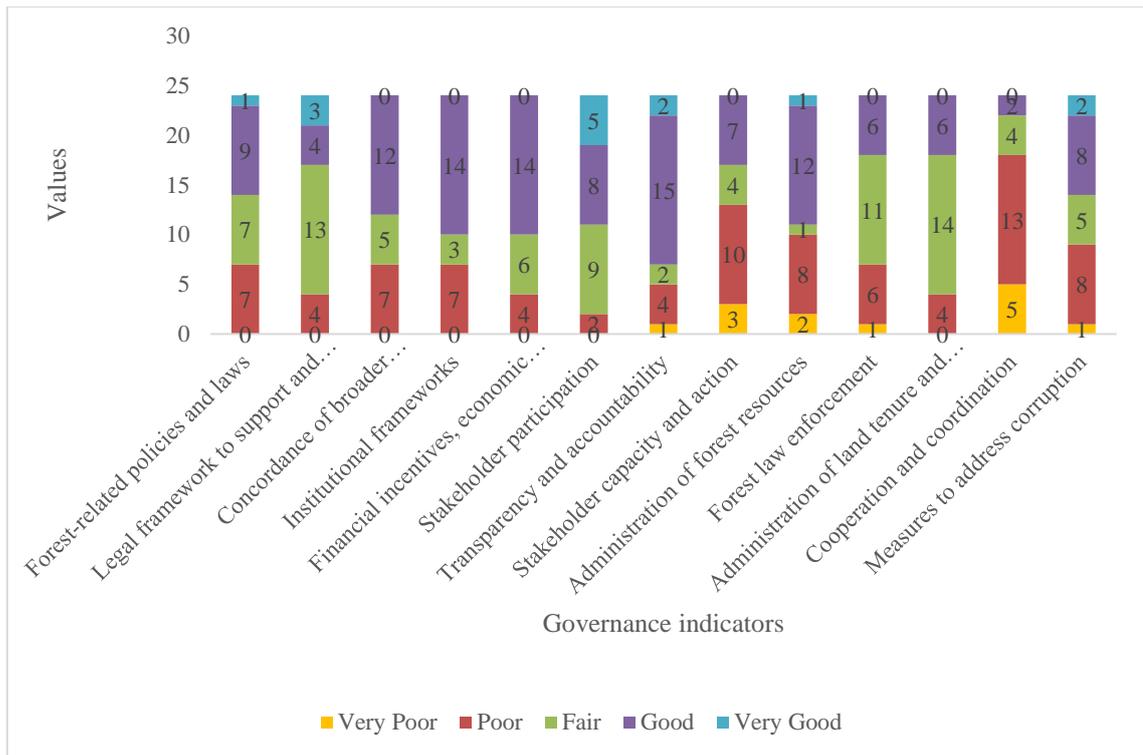
Figure 16: Status of different governance indicator of Gyadipakha CF

4.3.6 Institutional governance of Jwaladevi CF

The overall governance status of Jwaladevi CF was found out to be 57.83% which falls on the fair category of the governance status. Among seven CFs Jwaladevi was found to have the poorest governance status. The analysis of opinion of 21 CFUGs member of Jwaladevi found that, among 13 indicators of the forest governance of FAO, 2011, Gyadipakha CF was found to have fairly low in most of the of indicators. Only a few indicators were functioning well in Gyadipakha which includes (i) Financial incentives, economic instruments and benefit sharing (ii) Transparency and accountability. Whereas many of the indicators seem to have satisfactory values in governance status, some of them include (i) Stakeholder participation (ii) Forest law enforcement (iii) Cooperation and coordination (iv) Measures to address corruption. In more details, cooperation and coordination seem to be the weakest among all the indicators of the forest governance.

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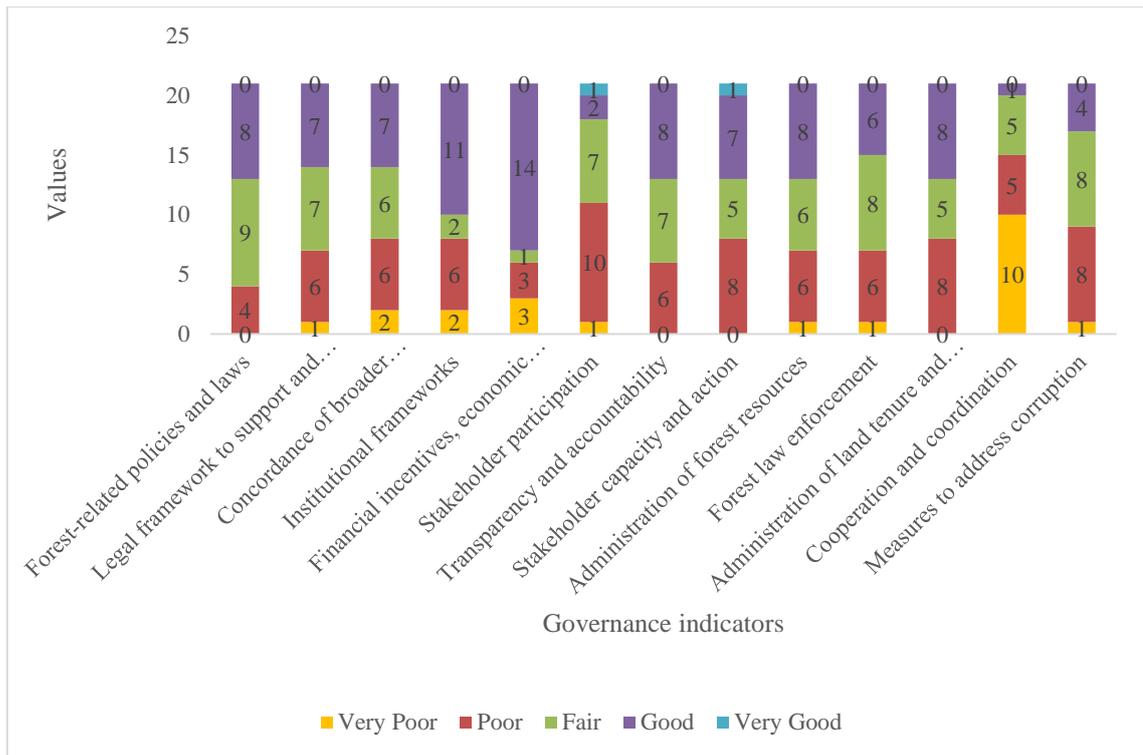
Figure 17: Status of different governance indicator of Jwaladevi CF

4.3.7 Institutional governance of Manakidanda CF

Manakidanda had the second poorest status of the governance among seven CFs of Udipur. The overall governance status of Manakidanda was found out to be 58.70% which falls fair category in the governance status. Among 13 indicators of the forest governance provided by FAO, only a few of them seems to be functioning good in comparison to another indicator in Manakidanda CF (CF having least governance). Few of the good indicators include (i) Financial incentives, economic instruments and benefit sharing and (ii) Transparency and accountability. Meanwhile, many of the indicators of forest governance were found to be satisfactory or weak in Manakidanda CF. Among 13, four of them seemed to major issues which include a (i) Legal framework to support and protect land tenure, ownership and use rights (ii) Forest law enforcement (iii) Administration of land tenure and property rights (iv) Cooperation and coordination.
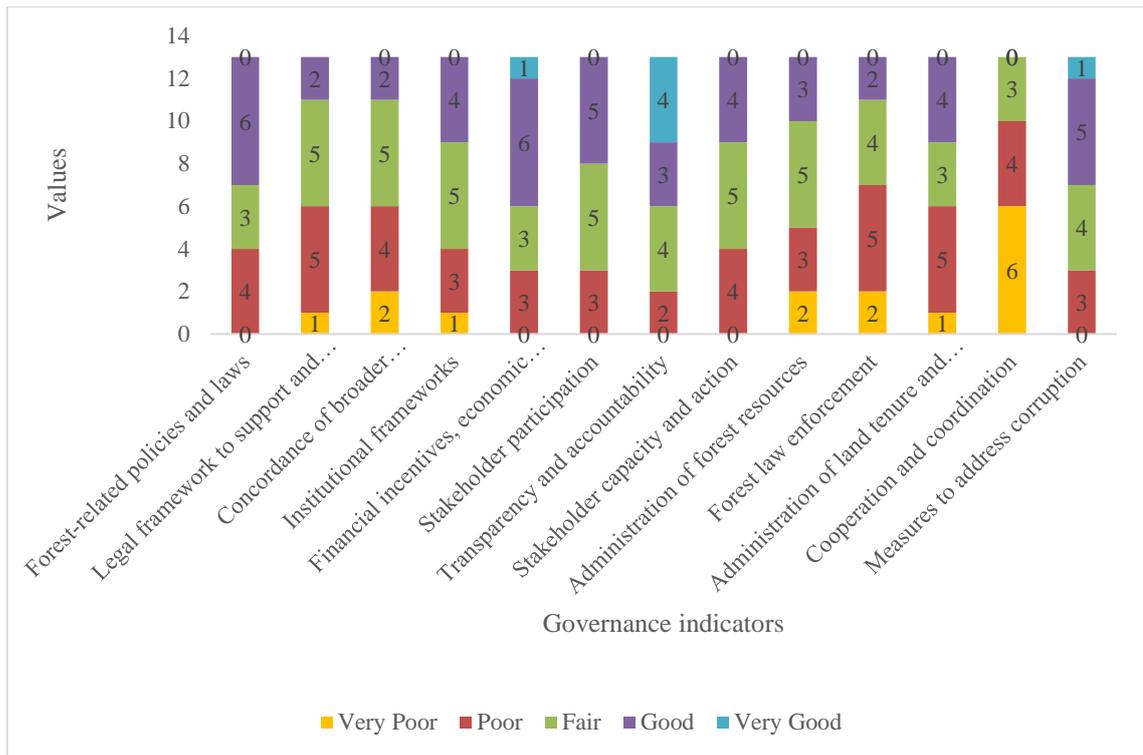
Figure 18: Status of different governance indicator of Manakidanda CF

4.3.8 Influence of governance on adaptation

From the Table 6, it was found that Kalika CF had the best governance among seven CFs of Udipur. In addition, Kalika CF was found to have the highest number of adaptation activities (28) carried out as well. On the side, Manakidanda CF was found to have the second poorest governance status (58.70%), it also had the least number of adaptation activities (7) carried out. Patalepani, Mandali, and Bankali were found have to governance status of little over 60 percentages, while they had a similar number of adaptation activities carried in their CF; 16, 15, 18 respectively. Gyadipakha CF had governance status of around 63% but it had carried out only 11 adaptation activities in it. Whereas, Jwaladevi CF had governance status of 57.82% while it had carried out 9 climate adaptation activities (Figure 19). The list of adaptation activities carried out in different CF is mentioned in Table 10.

$y = 0.952x - 46.854$
$R^2 = 0.9286$
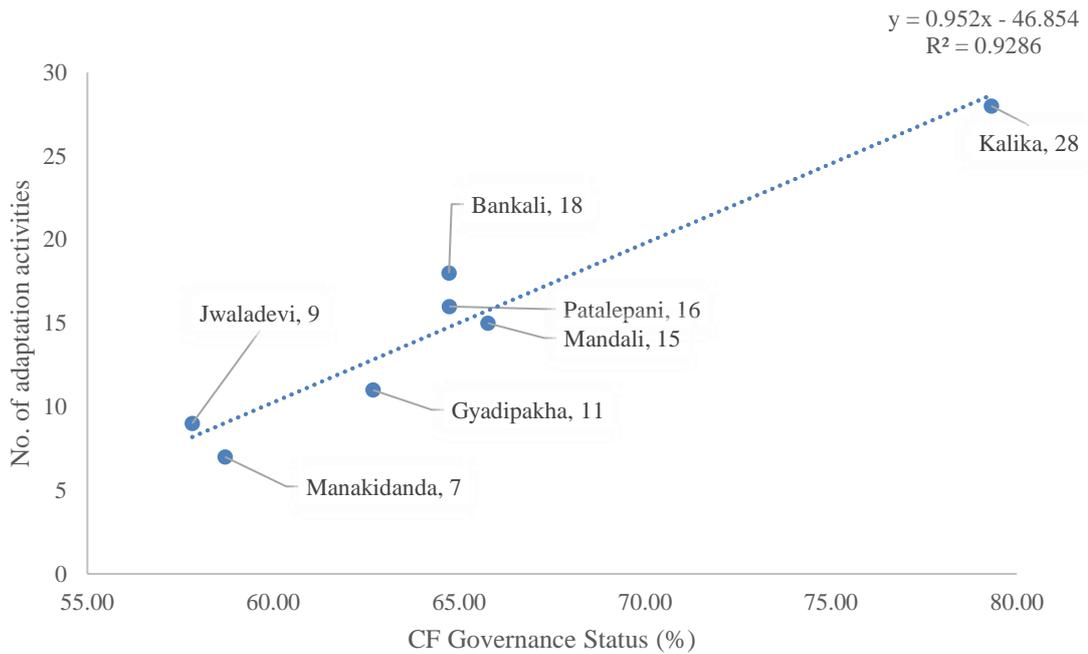
Figure 19: Relation between institutional governance and number of adaptation activities

Table 6: Governance status and number of adaptations activities

SN	CF name	CF Governance Status (%)	No. of activities
1	**Patalepani**	64.4	16
2	**Mandali**	65.78	15
3	**Kalika**	79.32	28
4	**Bankali**	64.73	18
5	**Gyadipakha**	62.69	11
6	**Manakidanda**	58.70	7
7	**Jwaladevi**	57.82	9

While correlating the overall governance status of each CF with the number of climate adaptation activities, it was found to have a highly positive relation. The Karl Pearson correlation coefficient value was found to be 0.945 (Table 7) which means they have extremely high positive relation. Furthermore, R^2 was found out to be 0.9286 which means i.e. when one variable increases another variable have the maximum possibility to increase as well. For example (Bankali CF had the highest governance status value and it also had the highest number of adaptation activities carried out it, whereas Manakaidanda had the poorest governance status value and had second least number of adaptation activities carried out it in). In addition, those CF which had the average type

of governance status (Patalepani, Mandali, Bankali) had an average number (among seven CF of Udipur) of adaptation activities (16, 15, 18) carried out in them.

Table 7: Karl Pearson correlation between governance status and no. of adaptation activities

Correlations

		CF Governance Status (%)	No. of activities
CF Governance Status (%)	Pearson Correlation	1	.945**
	Sig. (2-tailed)		.001
	N	7	7
No. of activities	Pearson Correlation	.945**	1
	Sig. (2-tailed)	.001	
	N	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.9 Effectiveness of adaptation activities in Udipur

Many adaptation activities have been carried out in the CFs of Udipur and the effectiveness of it was also studied. This study found that 67% of the respondents believed the adaptations activities to be effective whereas 22% believed there has been no change before and after the adaptation works. Remaining 11% said they have no idea about it. The effective adaptation activities have somehow decreased the vulnerability to the climatic stress.
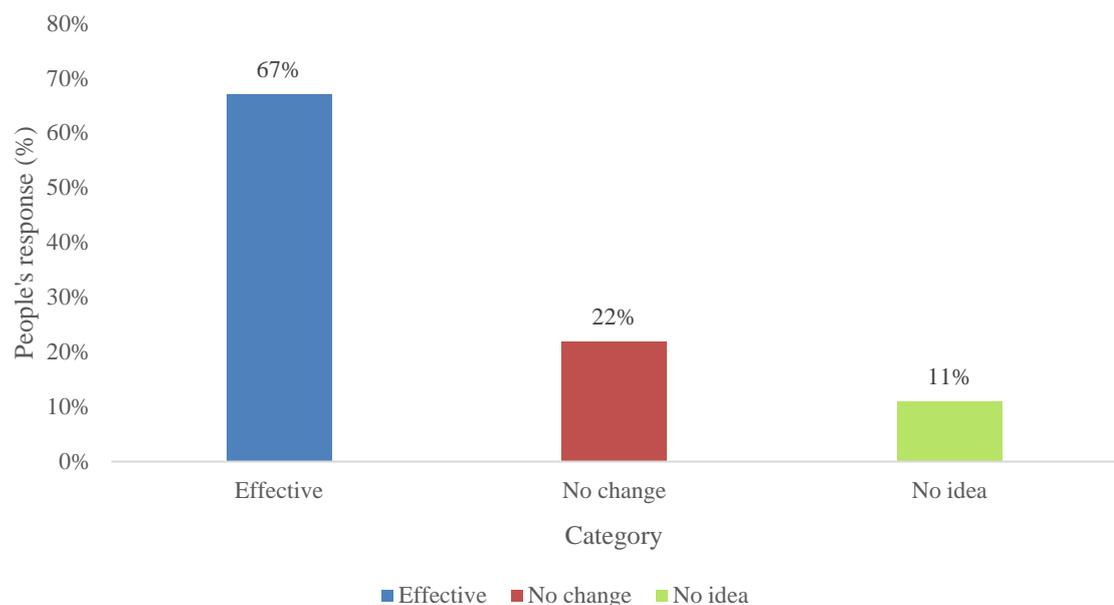
Figure 20: People's response on the effectiveness of climate adaptation activities

4.4: Facilitating and constraining factors for climate adaptations in CFs of Udipur

230 household surveys, seven FGDs, 10 KIIs and expert consultations were done to assess the major factors involved enhance or lessen up the climate adaptation process of community forests. Five facilitating and 11 constraining factors faced by seven CFs of Udipur we found out by the study.

4.4.1 Facilitating factors

Facilitating factors for promoting climate adaptation were identified from the study. Factors on the basis of the importance/weight include (i) Good governance (coordination and networking, transparency, accountability, and resources access) (ii) access to adequate infrastructure (iii) access to technology (iv) wider network and (v) alternative income generation option. The analysis of the data shows that besides good governance, access to adequate infrastructures like the road has also a significant role to play to make the adaptation work effective which in return help in decreasing the vulnerability of the local people to climate change. The wider networking and collaboration of CF with other organization seems to have played a positive role in enhancing the adaptations activities in CF of Udipur.
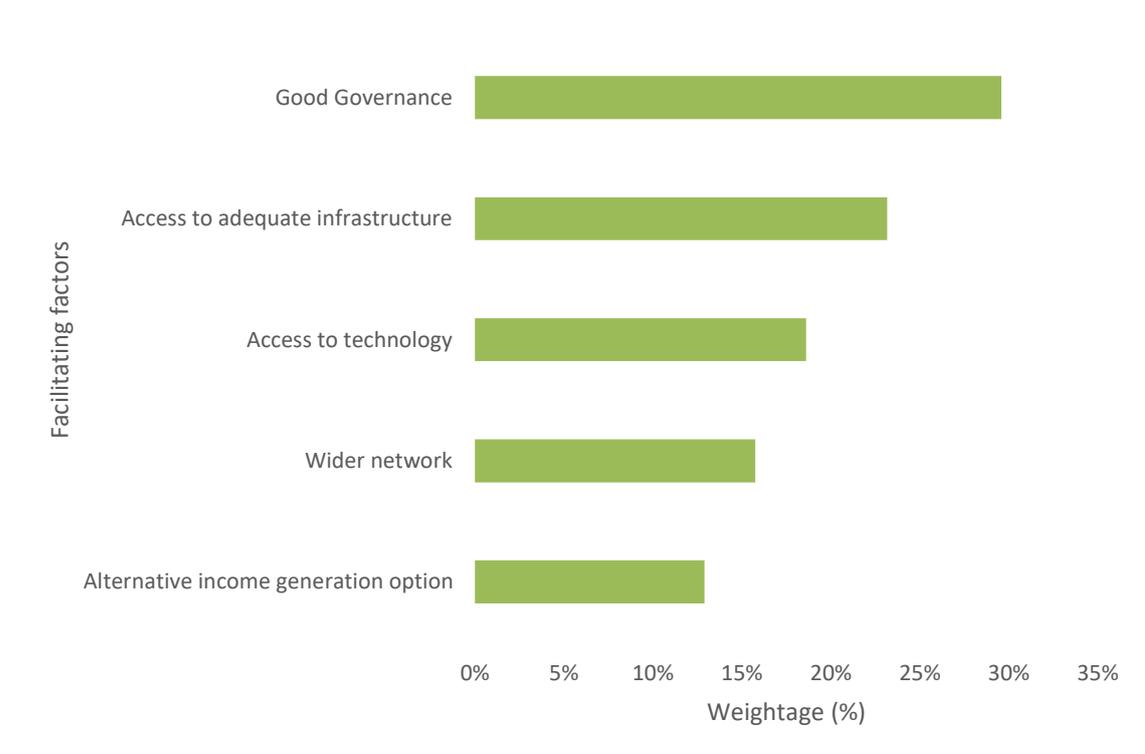
Figure 21: Facilitating factors for climate adaptations

4.4.1.1 Road access and number of adaptation activities

As a representative of all facilitating and constraining factors for climate adaptation in CF of Udipur, access to the road was further analyzed statistically. As road access is one of the infrastructures for development, thus its importance for climate adaptation was studied. The distance of CF to the main road was calculated by using google earth and by from consultations with the locals. It was found that Patalepani, Mandali, Kalika, and Bankali were less than 1km from the main road whereas Gyadipakha, Manakidanda, and Jwaladevi were in a distance of more than 1km from the main road. Kalika was the closest to the main road with the distance of 451 m where as Gyadipakha was the farthest (1556 m) from the main road among 7 CFs of Udipur.

Table 8: Distance from the main road and number of adaptation activities

SN	CF name	Distance from main road (m)	No. of activities
1	Patalepani	914	16
2	Mandali	612	15
3	Kalika	451	28
4	Bankali	660	18
5	Gyadipakha	1556	11
6	Manakidanda	1502	7
7	Jwaladevi	1473	9
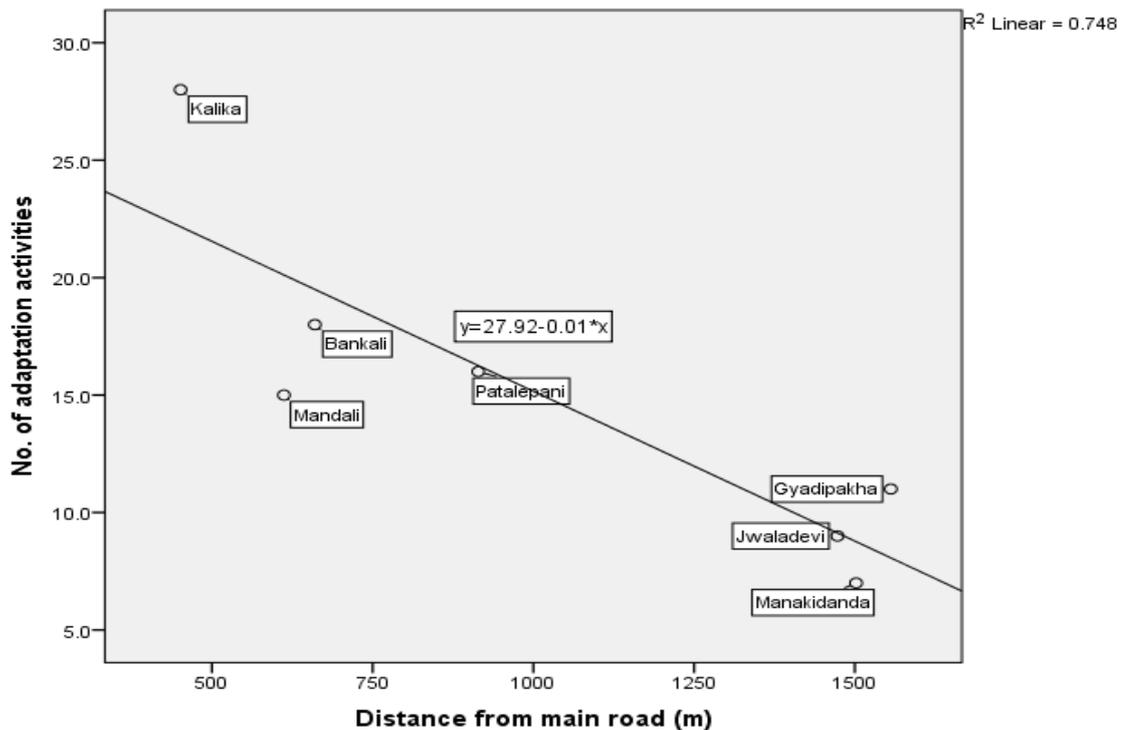
Figure 22: Distance from the main road and number of adaptation activities

The find the statistical relation between the distance from the distance of the CF from the main road, correlation test was done. The test found that two variables have a high negative correlation (r = -0.865) (Table 9). This means that if one variable tends to increase another will tend to decrease and vice versa. In the study, it showed that, if the distance from the road is less than there is a high possibility of having a high number of climate adaptation activities. Similarly, if the distance from the main road is high than that CF is supposed to have less number of adaptation practices. The Figure 22 showed Kalika CF had the shortest distance from the main road and hence it had the largest number of adaptation activities. Whereas, Manakidanda was the second farthest CF from the main road and it had the least number of adaptation practices carried out there.

Table 9: Karl Pearson correlation coefficient between number of adaptation and distance from the main road

Correlations

		Distance from main road (m)	No. of adaptation activities
Distance from main road (m)	Pearson Correlation	1	-.865[*]
	Sig. (2-tailed)		.012
	N	7	7
No. of adaptation activities	Pearson Correlation	-.865[*]	1
	Sig. (2-tailed)	.012	
	N	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

4.4.2 Constraining factors

Few facilitating factors limiting the effectiveness of climate adaptations in CF of Udipur were analyzed. The analysis of the data found nine major constraining factors to climate adaptation in the study area. Top five constraining factors on the basis of their importance/weightage includes (i) poor awareness of adaptation among local people, (ii) inadequate support from government, (iii) inadequate budget of CF for adaptation, (iv) political interference during adaptation works, (v) poor implementations of the operational plans of CF. If we are to bring best from the adaptation practices that are designed to decrease the vulnerability of the local people then all these constraining factors should be given utmost priority.
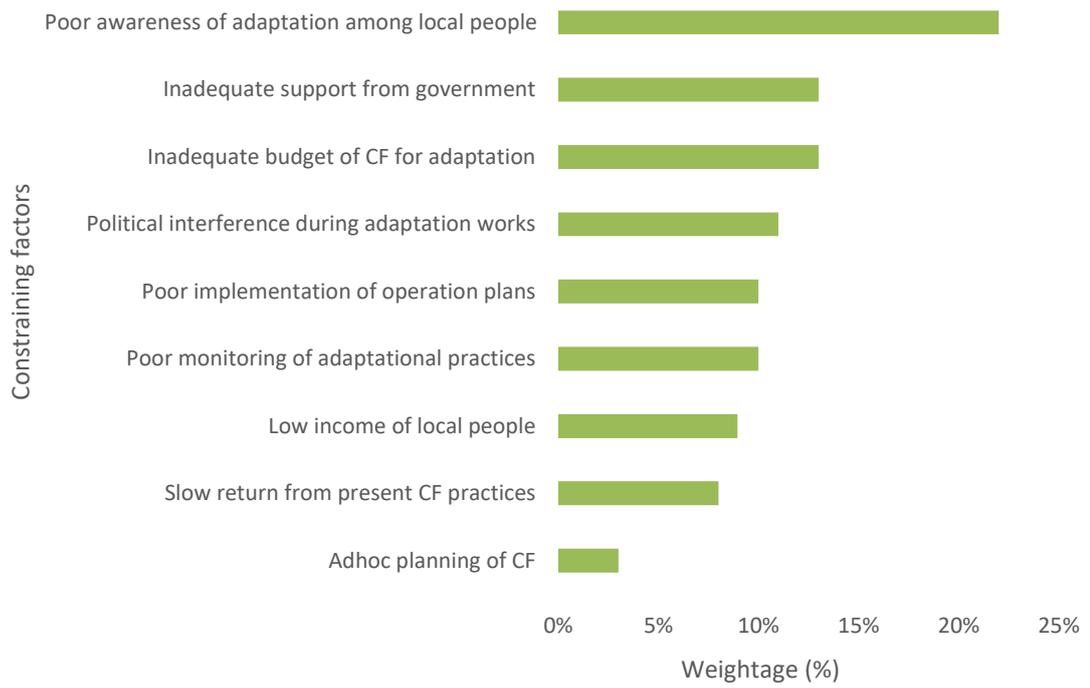
Figure 23: Constraining factors for climate adaptions

CHAPTER 5: DISCUSSION

5.1 Climate change trend in Udipur

Analysis of the annual precipitation trend found that it has been erratic. Huge difference in annual precipitation was found which tells us that climate of the study area has been really changing. As said by (Shrestha et al., 2000), the reason behind the insignificant trend of precipitation data and the erratic precipitation pattern might be because of some climatological phenomena like El Niño. The climatological patterns are being unpredictable and hence affecting the local people. ADB 2009; Dixit et al., 2016; Shrestha et al., 2000 adds, erratic and extreme precipitation events are likely to accelerate recurrent water-induced disasters like floods, landslides, soil erosion, sedimentation and drought and shorter periods of heavy rainfall, hence the local people will be more vulnerable to climate induced disasters.

Moreover, the annual precipitation seems to be decreasing in the area nearby Khudibazar station and in the recent year, it has been so proclaiming. The decrease or uneven trend of precipitation have major implications on the life of the people who are water dependent. Many people of the study area have agriculture as their major income source, a decrease in precipitation pattern might decrease the productivity from their farmland which might pose serious impacts in their profession and livelihood as a whole. Many research finding adds to the problem, INDC of Nepal, 2016 said the annual precipitation across the country is projected to reduce in a range of 10 to 20%. The decrease in precipitation will add up to the vulnerability of the water dependent people. This means that problems are only going to increase if we are proper adaptation soon.

Similarly, the analysis of the seasonal trend of the yearly average of both summer and winter temperature found that both summer and winter was on increasing. More specifically, winter temperature seems to increase at a rapid pace than summer temperature. And this fact is similar to what was found in other literature (Shrestha et al., 1999). Increased temperature may cause serious implications in the livelihood of the people by accelerating in the recession of glaciers and snowfields, which may affect the overall seasonal, annual water yields and the rivers discharge (Dixit et al., 2016). This study also found various impacts at local level like decrease in agricultural productivity, increase of invasion, increase of pest attack and disease and few others. Climate change impacts are considered to impacts the overall development of the country if proper adaptation and mitigation measures are not taken timely.

Perception of people of Udipur was also analyzed to find out the understanding level towards climate change. The perception and DHM data seem to match each other to a large extent. Thus, we can say that people of Udipur of have a good understanding about major two parameters of climate change i.e. temperature and precipitation. According to them, the summer is becoming more hotter and the winter is becoming less cold. Similar scenario was found in the other part of the country (Shrestha et al., 1999; Practical Action, 2009).

This finding can play significant role in reducing the vulnerability to climate change. In one hand, we have research that says the climate has been rapidly in recent years, on the other hand, the local people seem to have a good level of understanding of its major two parameters. Thus, with sustainable adaptation strategies, it can help to decrease the vulnerability of the people. Moreover, Lamjung being ranked high in many disasters, the local institutions of here like community forests have a huge role to play to reduce its vulnerability of this area by the implementations of smart adaptation practices.

5.2 Existing governance status of CFs and their role in climate adaptations

The analysis showed that only one CF of Udipur had higher good governance (Kalika CF). Whereas, Patalepani, Mandali, Bankali, and Gyadipakha felt in the category of lower good governance status. Remaining two CF i.e. Mankidanda and Jwaladevi fell in that category of fair governance. Not any governance pillar should be overlooked, if few pillar is not functioning well then it will affect the overall governance status of the CFs as a result of which adaptive capacity will be hindered. For example, in Manakidanda and Jwaladevi CF few indicators were functioning very poorly and this affected the overall governance status of those CF.

Institutional governance of the community forests of Udipur has been playing a huge role to enhance the climate change adaptations activities (Adger, 2009; Bauer et al., 2012; Jones & Boyd, 2011). This study also found that the status of the governance and number of adaptations activities have a very high correlation. It means if we have very good governance than it could make the pathways to have a high number of adaptation activities. Among seven CFs in the study area, Kalika had the best governance as compared to others, it had also the highest number of climate adaption activities.

This suggests, to have many adaptations activities/measures to be carried to reduce the vulnerability, strengthening the governance of the institutions should be given high

importance. Kalika seems to have way more number of climate adapation activities than other CF having comparetively weak governance.

CFUGs of Kalika CF have followed a different type of adaptive measures for type climate hazards. For eg. for drought they had established irrigation with meter system, for the adaptation to forest fire they made fire line, to adapt with hail they have provided plasctics tunnel to many CFUGs members as a adaptation measures, for landslide they have constructed few bioengineering structures. Altogether, Kalika had 28 different type of adaptation carried out. Whereas Manakidanda having poor goverance had only seven adaptation measures carried out.

In addition, this study also found that the adaptation activities carried in Udipur have been effective. They have been able to reduce the extent of the impacts posed by the climate change, thus helping to reduce the vulnerability of the people. This adds up to the fact good goverance has huge role to play if we are to decrease the climate vulnerability of an area.

However, among the 13 forest governance indicators, different CF seems to have a different problem. But when we talk about specific indicators following finding were drawn.

It was found that cooperation and coordination were seem to be very problematic in many CFs of Udipur. Four (Manakidanda, Gyadipakha, Jwaladevi, and Patalepani) out of seven CF, had this indicator of the forest governance in the very problematic state. Lack of coordination with other organization was limiting the climate adaptation activities of CF. As Sitoe & Guedes, 2015, this study also suggested those CFs whose coordination was good was found to have better adaptation activities and those CF which coordination and cooperation were very poor had very fewer adaptation activities performed. For an example, Kalika CF had best cooperation and coordination with other organization and thus they were found to have done the maximum numbers of adaptation activities. Whereas, Manakidanda had the one of the poorest networking and thereby it had less number of adaptation activities. Cooperation and coordination (networking) seem to have a high influence on the performance of the community forests. Hence, it was found to be one of the most determining factors to enhance the climate adaptation.

Transparency and accountability were found to be functioning poorly mainly in Bankali, Mandali, Patalepani, and Jwaladevi. The decision was made on the ad-hoc basic and it wasn't openly shared CFUG member. Meeting with CF committee members and CFUGs

was rare. CF committee was not found to be accountable as well. The essential criterion of good governance like auditing and handing the responsibility was not practiced in accordance with their operation plan. Poor transparency and accountability may lead up to the poor functioning of the institutions. (Chhetri, 2006; Kanel & Kanel, 2004; Pokharel & Niraula, 2004; Upreti et al., 2004) argued that for better functioning of the CF, transparency, and accountability should be given major concern.

Another challenge of governance was elite domination. Groupism prevailed there and the elite group found to dominate and the weaker one. A number of studies in Nepal have also found that in community forestry institutions, elite domination is prevalent (Dahal & Chapagain 2012; Kanel & Kandel 2004; Ojha et al., 2009). In many CF of the Udipur, the mostly elite group made decisions for their benefits. This was found that elite group domination was leading to bias in resources mobilization as well as in adaptation measures. For e.g. weaker groups like lower caste people have been facing the huge problem of water shortage and the climate induced stress like drought are adding up to their problems. Those weak groups is not allowed to use water resources freely. In the regards of this in many CF, they have managed a separate water tank or tube well for people of lower caste but it still doesn't seem to be enough for many of those people. Whereas, elite group domination is sometimes leading to corruption. Recently corruption seems to be an emerging issue in many CFs of Nepal and the measures to address it is hard to solve (Kanel & Kandel, 2004; Kanel & Niraula, 2004). Like in another part of the country, corruption of forest resources seems to prevalent and a measure to address corruption also seemed to be functioning poor in CFs of Udipur.

Similarly, forest related policies and laws were also problematic. They were found to be a weak functioning indicator in Bankali, Kalika, and Patalepani mainly. The finding shows that according to the local people community forests related guiding documents are outdated and they are not community and people centric. People are not allowed to utilize the resources in optimum amount. The laws are bounding them to not to utilize the resources when they need it which is compelling them to harvest the resources illegally. This scenario is creating a problem in Udipur. As it is said, community participation is very necessary for the success of any community based activities, thus it is suggested to make a law which environmentally sustainable and socially acceptable. If we are able to give few more benefits with consideration of ecological sustainability to the local people then it might lead to the success in community based activities.

(Kanel & Kandel, 2004; Kanel & Niraula, 2004; Lamichhance & Parajuli, 2014; Davis et al., 2013) also found the pitfalls in the governance of the CF in Nepal. Thus, to address the forest governance of Udipur, Lamjung all the 13 indicators should be given utmost priority.

5:3 Factors facilitating or constraining the adaptations

As suggested by (Adger, 2000; Agrawal 2008; Jones & Boyd, 2011; Koch et al., 2007; Smit & Pilifosova 2007) institutional governance was found to be playing a positive role in climate adaptations. Similarly, there are few facilitating and the constraining factors in climate adaptation. This study was able to find out five facilitating and nine constraining factors for climate adaptation.

Starting from the facilitating factors, good governance (mostly coordination and networking, transparency, accountability, and resources access) of the institutions was found to be the most important factors that have been playing a positive role to increase the adaptive capacity of a people/community. Besides this, access to adequate infrastructures was another. In this study, road access is taken as an infrastructure and found the distance to the main road and the climate change adaptations activities have a positive relation. Good access to road has increased the adaptation activities in the study area, it can be compared between Kalika CF and Jwaladevi CF as an example. Thus, it can be a reference to the policy makers and developmental organization that access (road and other infrastructures) should be considered while doing the adaptation activities. But this doesn't mean that we have to clear up all our natural resources and start constructing roads for the sake of building infrastructures. The sustainable approach should be applied. Moreover, for those institutions which have poor access to infrastructure should be given more priority than the institutions which have good access to infrastructure. In the case of Udipur, CF like Manakidanda, Jwaladevi, Gyadipakha should be given more priority than Kalika CF because of their limited resources access.

Access to technology was another major facilitating factor for adaptation practices in CFs of Udipur. CFUG member were still dependent heavily on traditional practices climate adaptations. Technology is not sound and up to date to bring best out of adaptation activities done by them. The effectiveness of the adaptation is also hindered by the outdated technologies and traditional practices. For example, they are still using the plastic tunnel to adapt to the hail. Though these plastic tunnels were helping to reduce the loss of crop, still tunnels were not found to be the sustainable approach to adaptation

because, at the time of extreme rain, storm and hail destroys it easily. However, it is considered that access to technology critical role in climate change adaptations and mitigation (Khatiwada 2012), so if we are to bring best out of any adaptation activities access to up to date technologies should not be overlooked.

Wider network and collaboration of CF with other organization found to have significant impacts in adaptation activities. The better the collaboration and coordination the more the adaptation practices. As said by (Sitoe & Guedes, 2015), wider networking helped the local institutions for bringing more adaptation program and the implementation of which help to increase the adaptive capacity of the community and thus decreasing the vulnerability. In the study area, Kalika CF was well supported by many other organizations, one of them includes Hariyo Ban program implemented by WWF-Nepal. While, CF like Manakidanda, Jwaladevi had less networking/collaboration with other organizations and fewer adaptation activities. Thus, networking also seems to have a big role in climate adaptations and should be prioritized.

Similarly, alternative income generation option to the CFUG member also played positively in climatic adaptation. Many people of Udipur were found to be dependent on the natural resources, and because of the law of the CF, they were not allowed to optimum resources from the CF. Poor, marginalized and natural resources dependent people are considered very vulnerable to climate to climate change because of limited adaptive capacities (Adger et al., 2003; Baker et al., 2012; Bharati et al., 2012; Dixit et al., 2016; Gurung et al., 2013; Hua, 2009; Huq & Reid, 2007; IPCC, 2007; OECD, 2009; Regmi et al., 2013; Rodledo et al., 2005). Thus, if alternative income generation option provided to the CFUG member who are dependent on natural resources, it will help to increase the adaptive capacity of the people.

This study also explores nine different constraining factors faced by the local institution during the planning and implementation of the adaptation activities. The constraints belonged to sociopolitical, economic and action based work.

Socio-political constraint from climate adaptation includes less awareness level of adaptation among the people, political influences, less support from the government, and ad hoc planning. All the nine factors were constraining adaptation activities. Like, less awareness about proper adaptation among the local people is resulting in less effective adaptation activities. Hence, the awareness level of the people should be enhanced to increase the effectiveness of the adaptation activities. Similarly, Political influences in CF

management mostly found during the time of committee member election and in decision-making process resulting in ad hoc planning. Similar, type of problem in CF was also found by the study done by Ojha et al. (2009). The political interference is impacting overall CF governance and hence the adaptive capacity. The policy makers should try to make CF as much politically neutral as possible to bring better outcome from it. But, local people were found to be getting less support (both technical and financial) from the government than expected. Researchers from (Chhetri 2006; Kanel & Kanel, 2004; Pokharel & Niraula, 2004; Upreti et al., 2004) also suggests that socio-political constraints should end from the CF to bring best of the CF program. Hence the government, as well as the concerned stakeholders, should also be very proactive to support it both technically and economically to solve the socio-political problems of the CF to bring best out of the adaptation activities. Economic problems were also constraining the adaptational works in the study area. among Problem like slow return from the forest resources, low income of the local people and the inadequate budget for climate adaptation of CF were halting adaptation activities. Many people of Udipur seems to be dependent on forest resources. But many of them said that the resource return period from the forest management is too slow, so, it is better and easy to sell the forest products like timber than to wait a longer time to earn the lesser amount of money via its conservation. This sort of activities will add up to their vulnerability to many climate induced disasters. Low income of local people is also driving them to harvest forest products illegally to sustain their livelihood. Thus, every stakeholder should consider this issue which planning any forest related or climate adaptations activities. The best option would be providing an alternative job to the forest dependent people. The fund allocation for adaptation activities by CF was found to be poor, thus CF should allocate sufficient fund for climate adaptation to reduce the vulnerability.

Besides this action based problems were also found to prevailing in CF of Udipur. Poor implementation of operational plans as well poor monitoring of adaptational practices were major problems. The operational plans were not found to be followed properly by all CFs. In addition, in the monitoring of any adaptation activities was rarely done. These things reduce the effectiveness of the adaptation activities so the concern should also go towards the implementation of the operational plans as well to monitoring the adaptation activities so as to bring best out of any adaptation work at the local level.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The findings show that the temperature and the precipitation pattern of the study area have been changing. The annual climatic trend shows that the maximum, as well as the minimum temperature of that station, is increasing at rapid pace. Meanwhile comparing the annual average temperature trend of summer and winter temperature shows that winter temperature has been increasing rapidly as compared to summer temperature. This also means that winter is being less cold and summer is becoming warmer. The perception of people further validates the outcome of station data. People have felt that the trend of temperature well than the trend of the precipitation. The changing climate has been impacting the lives and the property of the local via different climate induced disasters like drought, storm, hail, extreme rainfall, pest attack on crops and others.

Community forestry is one of the important institutions of Udipur working on restoring the ecosystem and managing natural resources to reduce the impacts of climate change. Analysis of governance status of all CFs was found that there are variations in the government structure and performances among the community forestry user groups. For example, Kalika CF had the best governance status while Jwaladevi CF had the weakest governance status. The study found that status of the governance and the number of adaptation practices adopted by the communities are dependent on each other. The better the governance status of the CF the more will the adoption of adaptation practices. Kalika had the highest number of the adaptation practices being carried out in it where as Jwaladevi had the second least number of adaptation practices. Thus, it is always good to focus on making the governance of the institutions strong to bring quality and quantity in the work done.

The study found few facilitating and the constraining factors for climate adaptation. Altogether five facilitating and nine constraining factors were found through HHs survey, FGD, KII, and expert consultations. Facilitating factors for climate adaptations includes the factors like good governance (network, transparency and accountability, resources access), access to infrastructures, easy technology transfer and other. Whereas, few constraining factors for adaptation include poor awareness about adaptation among local people, inadequate support, less budget, political influences and others. One of the facilitating factor; access to the road was statistically analyzed and found that better the access to the main road more will be adaptations activities.

Thus, in the scenario of rapidly changing climate, local organizations have a big role to people to minimize the vulnerability of the local community/people. the internal governance of institutions determines the quantity as well as the quantity of the adaptation practices. Thus, improving the governance of the intuitions will help to improve the working efficiency and effectiveness. From the findings, it also shows that besides fixing good governance, the basic services like access to good infrastructure, technology transfer should also be considered to bring best out of any adaptation activities.

6.2 Recommendations

(i) This study lack in depth study of the effectiveness of the adaptations activities and its relation to the good governance. Thus, further study to find the relation between the effectiveness of any adaptation practices due to good governance can be done.

(ii) Both technical and financial support for CF climate adaptation was found to be poor from the side of government. Thus, government should provide adequate support to the CF to reduce the vulnerability of the people/community.

(iii) Common issues of governance like accountability, transparency, rule of law found to be prevailing in few CF of Udipur. It is recommended to the stakeholders working on climate adaptations, to give the concern to make the governance of any institutions good to bring best out of adaptation works.

(iv) It is recommended to all the stakeholders including government to give focus on both the constraining factors and the facilitating factors for adaptation found by this study to bring best out of adaptation activities.

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Appendices

Appendix 1: Supplementary table

Table 10: Adaptation activities carried out in different CFs

SN	Adaptation activities	PCF	MCF	KCF	BCF	GCF	MdCF	JCF
1	Water tank construction			✓	✓			
2	Tap water system		✓	✓		✓		
3	Provided water pipe			✓				
4	Meter system in water	✓	✓	✓	✓	✓		
5	Canal irrigation			✓		✓		
6	Potholes construction			✓				
7	River water for irrigation			✓	✓			
8	Water management	✓	✓	✓	✓			
9	Fire line	✓	✓	✓	✓	✓	✓	✓
10	Forest guard	✓		✓				
11	Locals involvement to settle fire	✓	✓	✓	✓	✓	✓	✓
12	Fire extinguishing tools			✓				
13	Forest management	✓	✓	✓	✓	✓	✓	✓
14	Fire extinguishing group formation			✓				
15	Plantation	✓	✓	✓	✓	✓	✓	✓
16	Built bunding	✓	✓	✓	✓	✓	✓	✓

#		C1	C2	C3	C4	C5	C6	C7
17	Tunneling	✓	✓	✓	✓			
18	Fencing	✓		✓			✓	✓
19	Change in agricultural practice	✓	✓	✓	✓	✓	✓	✓
20	Provided timber and fodder in cold	✓		✓	✓			
21	Trainings, seminar	✓	✓	✓	✓			
22	Medication for people		✓	✓	✓			
23	Health post			✓				
24	Insecticides and pesticides	✓	✓	✓	✓	✓		✓
25	Provided seeds			✓	✓			
26	Gabion walls construction	✓		✓		✓		✓
27	Manure	✓	✓	✓	✓			
28	Plastic pond			✓	✓			
29	Research		✓					
	Total	16	15	28	18	11	7	9

Appendix 2: Field photographs

Photo 1: FGD with CF committee members of Kalika CF
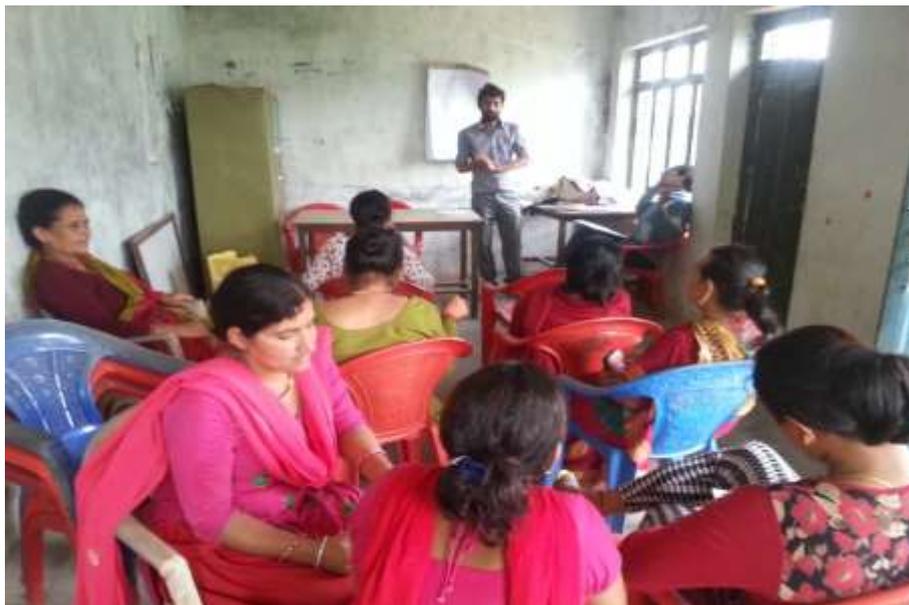
Photo 2: FGD with women's group of Mandali CF

Photo 3: KII with DFO of Lamjung

Photo 4: HHs survey with a respondent of Jwaladevi CF

Photo 5: KII with one of the elder respondent of Manakidanda CF

Photo 6: Group photo of people who helped me in data collection (Myself in extreme left)

Appendix 3: FGD particapants lists

Photo 7: FGD participants list from Patalepani CF

Photo 8: FGD participants list from Mandali CF

Photo 9: FGD participants list from Kalika CF

Photo 10: FGD participants list from Bankali CF

Photo 11: FGD participants list from Gyadipakha CF

Photo 12: FGD participants list from Jwaladevi CF

Photo 13: FGD participants list from Manakidanda CF

Appendix 4: Schedule for HHs survey

<div align="center">

Household Survey (Tool: Schedule survey)

</div>

Objective:

- To analyze the trend of climate change of over 30 years and peoples understanding of climate change in the study area
- To assess the existing governance status of CFs and their role in enhancing climate adaptations in the study area

Participants: Randomly selected households representing both male and female.

Time: 30 minutes

<div style="border:1px solid black; background:#d9d9d9; display:inline-block; padding:10px;">

Schedule Number:

</div>

<div align="center">

Household survey schedule for a study on
"Understanding Climate Change and Role of Community Forestry Governance in Climate Adaptation: Cases from Udipur, Lamjung"
CDES-TU/ICIMOD

</div>

Section 1: Identification

Q. No.	Questions and filters	
101.	District Name	
102.	Settlement (city/town/village) name	
103.	CFUG	
	Interviewer's information	
104.	Name of interviewer	
105.	Date of interview	____/____/_____

<div align="center">X</div>

Section 2: Socioeconomic Roster

<table>
<tr><td>a.</td><td colspan="2">VDC</td><td></td></tr>
<tr><td colspan="4">Code for Village: Hill-1; lowland-2</td></tr>
<tr><td>b.</td><td colspan="2">Name of the Village</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td>c.</td><td colspan="2">Name of respondent</td><td></td></tr>
<tr><td>d.</td><td colspan="2">Sex</td><td>1. Male
2. female</td></tr>
<tr><td>e.</td><td colspan="2">Age</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td>Code: 1- 13 to 25; 2- 25-49 ;3-49 to 60 ; 4->60</td></tr>
<tr><td>f.</td><td colspan="2">Education</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td>Code: 1-Illiterate (can't read or write at all)
2-Literate 3-<5 std 4-SLC 5.+2 6.Graduate 7.Degree</td></tr>
<tr><td>g.</td><td colspan="2">Ethnic group</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td>Code: 1- Brahmin/chhetri; 2- Newar ;3- Janajati ;4- Sarki, 5-Others</td></tr>
<tr><td>h.</td><td colspan="2">Religion</td><td>1. Hindu 2. Buddist 3.Muslim 4.Christian</td></tr>
<tr><td>i.</td><td colspan="2">HH source of income (%)</td><td>Primary:</td></tr>
<tr><td></td><td colspan="2"></td><td>Secondary:</td></tr>
<tr><td></td><td colspan="2"></td><td>Code: 1-Farming; 2-Wedge labour ; 3-Local business ; 4-Service; 5- Remittence ;</td></tr>
<tr><td rowspan="5">j.</td><td rowspan="5">HH Monthly expenses</td><td>Total</td><td></td></tr>
<tr><td></td><td>Code (upto): 1-<5000 ; 2-1000 ; 3-15000 ; 4-20000 ; 5-25000; 6-25000+</td></tr>
</table>

Heading	Fooding	Education	Energy	Transportation	Communication	Other
Rank						
%						

Section 3: Status of Community Forestry (CF)

k. What are the forest products you assess from CF?
1. Firewood   2.Grass/Fodder   3. Timber   4. NTFP   5.( )

l. How often are you allowed to collect forest products from Community forest?
Once in a week   2. Once in a monthly   3. Bi-monthly   4. ( )

m. Do you think the quality of forests has increased in last 20 years?
No- 0,   Yes- 1
How?

………
………………………………………………………

………
………………………………………………………

n. Have the benefits from community forest increased over the year?
No- 0,   Yes- 1

o. Are you satisfied with the services from CF?
No- 0,   Yes- 1

Section 4: What is households' perception of weather variability and climate changes?
4A: Temperature and rainfall

Q. No.	Question	Response (if Yes, respond to next column)	
401.	Have your household observed any change in temperature patterns in last 10 years?	Yes = 1 No = 0	Increased =1 Decreased=2 Uneven= 3
402.	Have your household observed any change in rainfall patterns in last 10 years?	Yes = 1 No = 0	Increased =1 Decreased=2 Uneven= 3
403.	Have your household observed any changes in summer temperature?	Yes = 1 No = 0	Increased =1 Decreased=2 Uneven= 3
404.	Have your household observed any changes in winter temperature?	Yes = 1 No = 0	Increased =1 Decreased=2 Uneven= 3
405.	Have your household observed any changes in the timing of the monsoon season?	Yes = 1 No = 0	Increased =1 Decreased=2 Uneven= 3

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Section 5: Households' perception of extreme events, the impact and response mechanisms

5A: What is the perception of households on Climate stresses and extreme events?

#	Natural hazards or extreme events attributed to environmental/ climate change (first, identify the main hazards/events of the locality)	Have you ever experienced the change in the following events in this area since last 10-20 years? Yes=1 No=2 Not applicable=3	If yes, how has its frequency and magnitude change since the formation of CF? Increased =1 Decreased= 2	During past 10-20 years to what extent has these events impacted/ affected you or your family? Very low=1 Low=2 Moderate= 3 High=4 Very high=5	Have you and your family been displaced or have to migrate due to attributed event and hazard to climate change? Yes=1 No=2 Not applicable= 3	Did you have to lose any property/ life due to climate induced hazards? Yes=1 No=2 Not applicable= 3	What has CF done to minimize the effect?
		501	502	503	504	505	
a.	Drought						
b.	Forest fire						
c.	Flood						
d.	Water logging/ inundation						
e.	Storm						
f.	Thunder storm/lightning						
g.	Hail						
h.	Extreme rainfall						
i.	Partial rainfall						
j.	Erosion						
l.	Landslide						

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m.	Snow storm						
n.	Glacial landslide						
o.	Outburst of glacial lake						
p.	Heat waves						
q.	Cold waves						
r.	Outbreak of diseases						
s.	Pest attacks on crops						
t.	Others (specify)						
u.							

p. Effectiveness of adaptation activities in Udipur?

(i) Effective   (ii) No change   (iii) No idea

5B: How household perceived the Impact of Climatic Stresses?

Extent to which households agree to environmental and climate changes

Q. No.	Questions and filters	Coding categories				
406.	I have with me some statements by people giving their opinion about different aspects of climate change. As I read out each statement, please tell me the extent to which you agree or disagree with that statement.					
		Very poor	Poor	Fair	Good	Very good
a.	Climate change is negatively impacting the services from CF (fodder, grazing, timber, NTFP etc.)	1	2	3	4	5
b.	CF support on climate change is not enough to deal with the issue	1	2	3	4	5
c.	Government support on climate change is not enough to deal with the issue	1	2	3	4	5
d.	Climate change is impacting agriculture sector mostly leading to declining productivity	1	2	3	4	5
e.	Food insecurity is increased due to extreme variability and hazards	1	2	3	4	5
f.	Invasive species is spreading and impacting the agriculture and forest areas	1	2	3	4	5

g.	Change in weather and climate is causing people to suffer more sickness	1	2	3	4	5
h.	Farmers now use less water for crops and animals than they used to 10 years ago	1	2	3	4	5
i.	Crop growing seasons are changing over the years	1	2	3	4	5
j.	Fresh water sources are being dried up over the years	1	2	3	4	5
k.	Crop productivity has declined over the years	1	2	3	4	5
l.	Crop pest attacks have increased over the years	1	2	3	4	5
m	Livestock diseases have increased over the years	1	2	3	4	5
	There are increased in occurrence and impact of natural hazards	1	2	3	4	5
n.	The loss and damage from the impact of climate change is increasing in recent years (losses at household level)	1	2	3	4	5
o.	Mostly women, children, poor and marginalized groups are impacted more by climate change	1	2	3	4	5
p.	The existing coping and responses is not sufficient to deal with climate change extremes	1	2	3	4	5
q.	The migration trend has increased due to water stresses and impact on agriculture productivity	1	2	3	4	5
r.	Climate change has impact on loss of CF biodiversity/resources	1	2	3	4	5
s.	Others	1	2	3	4	5
t.		1	2	3	4	5

Section 6: Institutional Governance

How household benefited from the forest resource management/arrangements?

407.	I have with me some statements by people giving their opinion about different aspects of effectiveness of governance arrangements. As I read out each statement, please tell me the extent to which you agree or disagree with that statement.					
		Very poor	Poor	Fair	Good	Very good
a.	Forest-related policies and laws	1	2	3	4	5
b.	Legal framework to support and protect land tenure, ownership and use rights	1	2	3	4	5
c.	Concordance of broader development policies with forest policies	1	2	3	4	5
d.	Institutional frameworks	1	2	3	4	5
e.	Financial incentives, economic instruments and benefit sharing	1	2	3	4	5
f.	Stakeholder participation	1	2	3	4	5
g.	Transparency and accountability	1	2	3	4	5
h.	Stakeholder capacity and action	1	2	3	4	5
i.	Administration of forest resources	1	2	3	4	5
j.	Forest law enforcement	1	2	3	4	5
l.	Administration of land tenure and property rights	1	2	3	4	5
m.	Cooperation and coordination	1	2	3	4	5
n.	Measures to address corruption	1	2	3	4	5

p. Is there any conflict in use of forest product among CFUG?
No- 0,   Yes- 1

q. Could you please mention major any two conflicts in forest product use?

-

-

r. How responsible are CF executive committee to solve the conflict?
1. Very much   2. Satisfactory   3. Low   4. Never

s. How often the conflicts are solved?
1. Always   2. Sometime   3. Occasional   4. Never

t. Conflicts have increased or decreased over the years?

1. Increased   2. Decreased

u. Good governance of the CF have increased or decreased over the years?
1. Increased   2. Decreased

v. Do you think better the intuitional governance better is the climate adaptation practices?

No- 0,   Yes- 1

w. In your opinion, what might be the reason for that?

-

-

x. In your opinion, what are facilitating and constraining factors for CF institution during adaptation practices?

-

-

Once again, thank you very much for your time and effort

Appendix 5: Checklist- Focus Group Discussion checklist

Objective:

- To assess the existing governance status of CFs and their role in enhancing climate adaptations in the study area
- To assess the challenges faced by the local institutions during climate adaptation processes

Participants: Executive member and general members of the organization including other stakeholders (N= 9)

Time: 1.30 minutes

Types of questions to be explored

a) Existing institutions in place: What are the existing institutions (both formal and informal) operating in the area? What is their major area of work? How many household or villages are covered by it? (Tool: use institutional mapping exercise to list and locate the institutions and the areas of their work including the household coverage and affiliation)

b) Governance process (rules and rule making process): What are the existing policies, rules, and rule making process within the institutions? (Tool: use Meta cards to identify and list policies and rules and its major elements in relation to the governance of forest including the rule making process)

c) Actors (or participants and organization) and their interaction (their interest, power, position, and legitimacy): Who are the major stakeholders and actors governing the institution and resources? What is their level of interaction in terms of collaboration and conflict (Tool: Use Power, Interest, and Legitimacy analysis (PIL) to identify the level of collaboration and conflict)

d. Networking and collaboration: How the local institutions interact with other institutions and what is the level of relationship? (Tool: use network analysis to map the network, relationship and level of engagement with other actors and agencies)? Have they benefited from government policies and support, if so list those examples?

e) Dealing with stresses: What are existing climate and environment stresses? How is the institution managing it?

e) Governance drivers leading to resilience building: What are some of the opportunities and achievements of institutional mechanisms? What are some of the constraints of such mechanisms? (Tool: use SWOT analysis or benefit and constraint

mapping), what are special provisions or benefits targeted to women, poor and vulnerable households?

f) What are the facilitating and constraining factors for local institutions in climate adaptation process?

g) What are the areas of improvement for future adaptation processes at the local level?

Appendix 6: Checklist- Key informants interview

Objective:

- To assess peoples understanding of climate change in the study area
- To assess the existing governance status of CFs and their role in enhancing climate adaptations in the study area
- To assess the challenges faced by the local institutions during climate adaptation processes

Participants: Selected executive member and general members of the organization including other stakeholders such as local stakeholders, practitioners from NGO/INGOs

Time: 40 minutes

General information about the existing socio-cultural context a) Demography, b) Major resources, c) Occupation, d) development facilities, e) Migration trend, f) cultural and religious context, g) political environment

General information about the existing weather variability and climate change and its impact in different sectors. What are the major climatic stresses, which particular livelihood resources are impacted and how it is impacting the livelihood of communities? Who is most impacted?

Institutional landscape: a) institution formation (types, history of formation, membership); b) Management: How the institution is managed? (existing policies and laws, priorities, decision-making body, participation status and benefit sharing mechanisms)

Networking with other organization and areas of collaboration

Organization role in dealing with environment and climate change stresses: what is the role of organization/ group in dealing with environment and climate change issues?

The scope of institutional work outcome of their work: How are they managing the forest resources? Firewood, Grasses/fodder and other

The level of engagement with the community in order to elicit issues of inclusiveness and targeted interventions: Who is involved in decision making? How communities' participation is ensured with the planning and decision making, how is benefit shared among the users? What are special provisions or benefits targeted to women, poor and vulnerable households?

Factors affecting their role, policies and political discourse shaping their work, resources available for performing their activities- internal and external factors (e.g. policy, government support etc.)

What are the facilitating and constraining factors for local institutions in climate adaptation process?

Areas of improvement: What are the areas of improvement for future climate adaptation measures taken at the local level?

THANK YOU!