

Gender Perspective: Integrating Energy Resource Use into Climate Change Adaptation

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Abstract

The study tries to link climate change with gender and energy (impacts, availability and access). Participatory Rural Appraisal tools, specifically, key informant interviews and focus group discussion (women only, men only and mixed group) were deployed in the indigenous Chepang community of Siddhi VDC in Chitwan. Results show that the community is chiefly dependent on traditional biomass fuels and eighty percent respondents presented that indirect effects have been seen on fuel wood resource availability and consumption but climate change cannot be solely responsible for this; meteorological data gives rainfall is increasing unlike people reported while temperature is increasing as people perceived. Anthropogenic causes like haphazard slash and burn agriculture practice in the Chepang community and increasing population might also be accredited for the decreasing availability of biomass fuel. The energy rapid assessment revealed that water based energy was the highest impact bearer among other energy resources due to climatic variability. The adaptive measures taken were establishment of institutions like Community forest to secure availability of the firewood in demand, migration to foothills to get away with the day to day drudgery of collecting firewood, agro forestry strategy, adoption of alternative energy like solar, Pico-hydro and ICS, shifting from the traditional slash and burn agriculture to subsistence farming and other income-generating activities like livestock rearing, micro-credit group formation. It was also found that women have major roles to play in collection, hauling and utilization of biomass energy for household chores; ironically, men have the access to information and decision right.

Keywords: climate change, energy impacts, gender, adaptation, Chitwan district, Siddhi VDC

Abbreviation

AEPC	Alternative Energy Promotion Center
AETs	Alternative Energy Technologies
CBS	Central Bureau of Statistics
CC	Climate Change
CDM	Carbon Development Mechanism
CF	Community Forest
CFUG	Community Forest Users' Group
COP	Conference of Parties
DDC	District Development Committee
DHM	Department of Hydrology and Meteorology
FGD	Focus Group Discussion
GHG	Green House Gases
HH	Household
ICS	Improved Cook Stove
IPCC	International Panel for Climate Change
INGO	International Non Governmental Organization
KII	Key Informant Interview
kW	Kilo Watt
LED	Light Emitting Diode
LPG	Liquid Petroleum Gas
MCCICC	Multi-sectoral Climate Change Initiative Coordination Committee
MoE	Ministry of Environment
NAPA	National Adaptation Program for Action
NDA	National Designated Authority
NGO	Non Governmental Organization
NTFP	Non Timber Forest Product
PVP	Praja Bikash Program
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VDC	Village Development Committee

Table of Contents

Acknowledgement.....	i
Abstract.....	ii
Abbreviation.....	iii
Table of contents.....	iv-v
1. Introduction.....	1
1.1 Background.....	1
1.2 Statement of problem.....	2
1.3 Objectives.....	3
1.4 Limitations and Challenge.....	3
1.5 Study Area.....	4-7
1.5.1. Siddhi VDC.....	4
1.5.2. Location of Siddhi.....	6
1.5.3. Poulation of Siddhi.....	6
1.5.4. The Chepang.....	6
1.5.5. Education	6
1.5.6. Alternative Energy.....	7
1.5.6.1. Electricity.....	7
1.5.6.2. Solar Energy.....	7
1.5.6.3. Biogas and Improved Cook Stoves.....	7
2. Literature Review.....	8-13
2.1. Climate change, gender and energy.....	8
2.2. Perception, of local people towards climate change.....	10
2.3. Climate change impacts on other resources and its relation to gender	11
2.4. Nepal’s Response to climate change.....	12
3. Methodology.....	14-17
3.1. Research Design.....	14
3.2. Data collection.....	15
3.2.1. Primary Data.....	15
3.2.1.1. Focus Group Discussion.....	16
3.2.1.2. key Informant Interview.....	17
3.2.2. Secondary Data.....	17
4. Results and Discussion.....	18-34

4.1. Results.....	18
4.1.1. Climate Change.....	19-23
4.1.2. Perception towards Climate Change.....	23-24
4.1.3. Impacts of Climate change in general.....	24-25
4.1.4. Study context.....	25-30
4.2. Discussion.....	30-34
5. Conclusions and Recommendations.....	35-40
5.1. Conclusions.....	35-36
5.2. Recommendations.....	36-37
References.....	38-40
Annexes	
Annex I Photo Plates.....	41-45
Annex II Checklist.....	46-48
Annex III List of participants.....	49-51
Annex IV Seasonal Calendar and Social Resource Map.....	52-53
List of Figures	
Figure 1: Site Map.....	5
Figure 2: Annual minimum and maximum trend of temperature of Rampur station.....	19
Figure 3: Annual mean temperature trend of regional station (Rampur).....	19
Figure 4: Annual mean rainfall trend of Rampur station.....	20
Figure 5: Linear trend of mean annual pre-monsoon rainfall of Rampur station.....	21
Figure 6: Linear trend of mean annual post-monsoon rainfall during monsoon of Rampur station.....	21
Figure 7: Linear trend of mean annual post-monsoon rainfall of Rampur station.....	22
Figure 8: Linear trend of mean annual winter rainfall of Rampur station.....	22
List of Table	
Table 1: Framework of fieldwork.....	15
Table 2: Linear regression statistics of temperature.....	20
Table 3: Linear regression statistics of rainfall.....	22
Table 4: Local perceptions and observed changes in climatic and environmental conditions.....	23
Table 5: History of climatic events as reported by respondents.....	24
Table 6: Energy rapid assessment.....	27

Chapter I

INTRODUCTION

1.1 Background

The Intergovernmental Panel on Climate Change's latest report states clearly that climate change is already having discernable impacts. Nepal's share in climate change is negligibly small. The population of Nepal is less than 0.4% of the world population and is responsible for only about 0.025% of annual greenhouse gas emissions (NAPA/MOE, 2009). However, Nepal is highly vulnerable to climate change impacts and so adaptation measures are to be taken. Climate change could have significant effects on the various sectors like agriculture, water, health etc and even in energy sector. Rising temperatures, changes the amount of precipitation, and variation in humidity, wind patterns, and the number of sunny days per year could affect both consumption and production of energy (Stern, 1998). So the climate change may affect the available energy resources while the sufficiency in energy resources indicates the adaptation status of the community.

In many developing countries, especially in the poorest areas, most energy currently comes from traditional biomass fuels such as wood, charcoal and agricultural wastes – and collecting and managing these fuels is strictly the business of women. It follows that the lack of recognition of the role of women in the energy sector, leads to „gender-blind’ energy policies that fail to address some of the most pressing factors affecting the capacity of developing countries to adapt and mitigate climate change (UN Women Watch, 2009). Gender is not restricted to the difference in sexes only but it is the socially built-on roles and responsibility of men and women to run the society more systematically. However, the hidden power structure behind the construction of gender has always favored the men than women and thus the gender difference in different parts of the society occurs, which has to be accounted and advocated (UNDP, 2010). Energy resource-use is one of such a realm in which the gender roles and responsibilities are different and thus the impact received due to the probable impacts on energy resource accessibility and availability due to climate change may differ gender wise. Thus the energy supplies, gender roles and climate change are linked together which can be more strongly illustrated in countries with low

availability of basic electricity and modern fuels, and high dependence on traditional biomass fuels for cooking, heating and lighting. (UN Women Watch, 2009). Rural women are most vulnerable to climate change as it is expected to exacerbate existing shortfalls in resources like fuel wood because the time taken to fetch wood (which in most countries is the responsibility of women) will certainly increase women's workloads and thus decrease the adaptive capacity which is why women need to be addressed. Local and traditional adaptive measures and practices regarding energy resources availability and accessibility taken by men and women might be useful information for others as well hence the documentation is required. This paper attempts to establish a relation between climate change and prevalent energy resource in the study site as well as it studies the consequent adoption strategies within the community taking special note of the gender perspective.

1.2. Statement of Problem

The impacts of climate change on gender relations have not been widely studied to date – they therefore remain invisible. Despite the difficulties of prediction, it is clear that the impacts of climate change will be gendered, and that these require further research (Nelson. et. al 2002). There is still limited information on the gender aspects of the causes and impacts of climate change, globally and in Viet Nam, as well as on the gender aspects of GHG mitigation and adaptation actions (Noi, 2009). Rural women are most vulnerable to climate change as it is expected to exacerbate existing shortfalls in resources like fuel wood because the time taken to fetch wood (which in most countries is the responsibility of women) will certainly increase women's workloads and thus decrease the adaptive capacity which is why women need to be addressed. Local and traditional adaptive measures and practices taken by men and women might be useful information for others as well hence the documentation is required. Adapting strategies like promoting clean and renewable energy suitable to village dwellers instead of traditional fuels such as fuel wood, crop residues, etc. and imported fuels like kerosene will reduce the climate change impacts as these are becoming scarce due to climate change itself. We could trace many studies regarding gender relating climate change, gender relating energy and climate change impacts on energy resources; however, a research study that links climate change, gender and energy is scarce. This study is an attempt to explore the association between these three issues.

1.3. Objectives

The general objective of the study is to understand the gender perspective in energy resource use in reference to climate change adaptation.

- i) Evaluating long term climate data (of precipitation and temperature) in order to determine the variation in climate of the study site
- ii) Assessing perception of rural people in climate change risk and its impacts on energy consumption and availability
- iii) Documenting the possible adaptive measures and practices i.e. relevant local and traditional knowledge taken in order to cope with energy unavailability
- iv) Assessing gender differences in energy access information

1.4. Limitations and challenges

This study encountered some challenges and limitations. The following are some of the limitations and challenges:

- The selection of the study sites that met all criteria was not an easy task. The Research team opted to select villages from the Siddhi VDC that had high vulnerability with respect to climate change (tallied from DHM data) and dependent on energy resources that are climate-influenced (by climate change) as well as which are not urban areas (not accessible by transportation). Because site selection was entirely data based, outcomes were different than expected in terms of visible impacts and climate change variability.
- The major limitation was time. Time allocated for planning and carrying out of the fieldwork was not adequate. Upon arrival in the study area, up to two days was spent on making contacts and seeking permission from the local government authority. A local person from Nibuwater was employed to assist in informing individuals participating in FGDs. Because the local meetings were held in the church only in Saturday, the schedule had to be adjusted accordingly.
- Data for Stream discharge and total annual rainfall days were not available, that were fundamental to the study.

- The attempt to include middle aged and elderly women in the Women only group was unsuccessful because only two elderly women and more young women made at the gathering.
- Out of the nine villages invited for the FGDs, participants from only three villages made on the gathering.
- The knowledge of local adaptation measures to climate change was limited.
- The impact of climate change in energy resources was less significant.

1.5. STUDY AREA

1.5.1. Siddhi VDC

Siddhi VDC (Village Development Committee) lies in Chitwan District, about 18 Kilometers north of the Ratnanagar Municipality. VDCs that border Siddhi are Kaule, Shaktikor, Lothar, Korak, Birendra Nagar & Chainpur. Siddhi VDC consists of 9 wards. This research covered 3 wards; Ward 2, 6 and 7 namely. Villages in Siddhi lie in a hilly terrain with slopes about 30° except for the Nibuwater village which is at a lower elevation and is relatively plain. Siddhi is an abode to indigenous Chepang community. The area almost completely consists of forest entirely handed over as community forests.

1.5.2 Location of Siddhi

Siddhi is located 17 kilometers north of the Mahendra Highway that runs across the Terai from east to west of the country. A feeder road from Tandi, a small market at the highway, in the south just touches the nearest accessible Shaktikhor VDC, at the border of Siddhi VDC. A jeep runs every 2-3 hours between Tandi and Shaktikhor; most of the path is a gravel stretch till Shaktikhor. From Shaktikhor, a trail leads to Tindobhan and further to other villages. Siddhi is inaccessible by road except Tindobhan, the district headquarter in Nibuwater ward. However, every year (except during the monsoon) with the donation of labor by the locals, the road

stretches further to the wards. As of now, it is a 15 minutes walking distance from Shaktikhor to the border of Siddhi VDC and another 2 and 1/2 hours trek to each of the village.



Figure 1: Site Map

Source: Bakker, 2009

1.5.3. Population of Siddhi

There are 3358 people living in Siddhi (CBS 2001). These people are living in 539 households so the average household size is 6.23 persons. 51% of the population is male and 49% is female. The population density is 63 persons per square kilometer where the population density of Bharatpur, the biggest city of the district, is 1282 persons per square km. Siddhi is the least densely populated area of Chitwan district. There are 2436 Hindu people in Siddhi, 659 are Buddhist and 263 are Christian. There are no other religions. Most people in Siddhi belong to the ethnic group „Chepang’ but in ward 1 and 2 there are some „Tamang’ people as well.

1.5.4. The Chepang

The Chepang are an indigenous people living in the upper hills of the central region of Nepal. Chepang comprise 85% of the people in Siddhi VDC. Their total population accounts to 55,000 and they are living across Chitwan, Dhading, Ghoroka, Makwanpur, Lamjung and Tanahun districts (DDC, 2001). They are a highly marginalized indigenous nationality. In addition to economic impoverishment, the Chepang have also confronted cultural discrimination since the „Muluki Ain’ (Civil Code) in 1854 but later the Chepang became known as the Prajas (King’s subjects), during late King Birendra’s regime. He recognized the miserable conditions that they lived in and started the “Praja Vikas Programme” (PVP) for the upliftment of the Chepang.

The Chepang often owned no land, as they wandered in forests where they could harvest natural resources. The Chepang settlements are often situated on marginal lands in hilly slopes. The Chepang do not have long history of agrarian lifestyle. As an indigenous group, Chepang have own unique language and spiritual beliefs. However, the Nepali language is dominant nowadays. Due to modernization, the traditional knowledge and values of the Chepang are under shadow.

1.5.5. Education

Primary schools can be found in almost every village in Siddhi. The nearest secondary school is in Shaktikor. This means that students have to walk for about 5 hours a day to go to school. Colleges can be found in Tandri, Bharatpur and some other town in the district.

1.5.6. Alternative Energy

1.5.6.1. Electricity

Siddhi VDC relies primarily on biomass for energy means. Introduction of alternative energy options is new i.e. only 3-4 years old. Only three wards in Siddhi have electricity, the benefitted ones are namely Nibuwatar, Deujar and Majhbang. Majhbang and Nibuwatar receive electricity from the national grid extended from Shaktikhor while inhabitants of Deujar enjoy the benefits from pico-hydro generated from their local river Deujar (3kW). Nibuwatar lies near Shaktikhor while Majhbang is a popular tourist destination; hence they both have electricity and basic infrastructures.

1.5.6.2. Solar Energy

The use of solar energy is basically limited to lighting solar-based night lamps (solar tuki) only in Siddhi VDC. Few of the villages profit from solar based household lighting. There are a total of 53 individual household solar systems and 84 small scale solar installations so far. The solar based household lighting system comes with a small solar panel that lights up two solar lamps (about 4 volts). Wards 2, 6 and 7 are using solar lamps extensively as supplement to electricity.

1.5.6.3. Biogas and Improved Cook stoves

Use of biogas or improved cook stoves in Siddhi is very rare. Biogas operation is inappropriate in a goat-rearing hilly community while improved cook stove (ICS) is still unheard of and few places where programs have been launched requires proper training, more importantly on operation and maintenance. In the absence of monitoring and follow up, few households that switched to ICS have returned to traditional stoves in lack of proper maintenance skills.

CHAPTER II

LITERATURE REVIEW

2.1. Climate change, gender and energy

Victor et al (2005) explained in rural and poor urban areas that drier conditions may lead to a decline in forests, resulting in reduced timber and fuel wood availability though another factor contributing to deforestation may be the high dependence on fuel wood or due to lack of alternative energy. According to his study, improving rural quality of life and promoting rural non-farm income such as rural electrification, providing grants and subsidies are the most important measure that reduces vulnerability and deforestation. He suggested that the use of alternative sources of energy and technologies, efficient utilization of energy like energy conserving ceramic stoves and improvement in charcoal burning methods and promotion of private sector participation in the development of both conventional and renewable energy sources could also improve quality of life.

Mahat (2003) advocated that women have key roles in managing household energy systems, and are more affected by rural energy alternatives than men. However, the limited involvement of women in planning, management and hands-on knowledge of such technologies had shifted the control of energy services from them to men.

Men and women will be differently impacted and vulnerable to climate change because of the existing inequalities such as unequal access to resources, gendered divisions of labor and decision-making power which may affect the ability to respond to the effects of climate change (WEDO 2007; Parikh 2007; UNFCCC 2007; BRIDGE, 2008)

The gender relates to energy and poverty as women and girls are generally responsible for kitchen activities in households and they spent their time gathering fuel, producing and processing food limiting their engagement in income generating activities and education. Cooking over poorly ventilated indoor fire poses serious health hazards to women and children (Gender, Poverty and Environmental Indicators on African Countries 2008). The noxious smoke

from indoor fires and stoves is associated with 1.6 million deaths per year in developing countries, mostly among women and children under five. (UNDP, 2010)

The reports published (UNDP, 2010; Riberio, 2010) argues that women and men are differently impacted by climate change/variability, depending on their roles and responsibilities and decision making structure in the households to community. Women being often poorer, less educated, exclusion from household decision-making and own fewer assets, limited mobility and more dependence on natural resources for their livelihoods are some of the factors that makes women more vulnerable towards climate change effects. Mostly in poor communities in most developing countries, women and girls are responsible for collecting fuels and the environmental degradation forces them to search a farther and thus, making them more vulnerable to sexual harassment and assault as well as to injuries from carrying heavy loads long distances.

Traditional cultural norms can affect women's ability to adapt to climate change. Nigerian rural women traditionally do not move outside their village, unexposed to new surroundings, putting them at greater risk when changes occur unlike men who often leave their villages to find work, t exploring different environments, gaining new skills and accumulating knowledge and resources (money, social networks, etc.) that are valuable for adaptation. However, women, learn solidarity and develop strong social networks.(UNDP, 2010).

Despite having the prominent role, women remain unrecognized in energy policy, planning and in the development of new energy technologies. Women are compelled to use biomass-based sources of energy because other cleaner, effective and affordable sources of energy are not available (International Parliamentary Hearing for Southern African Legislators. 2010).

Sherpa (2009) attempted not just to highlight a correlation between hardship of mountain women and climate change, but more importantly a direct causal link between the degradation of women's livelihood and climate change. Due to climate change and global warming the snowline in these mountain regions are moving increasingly northward, resulting in the depletion of rangelands and thus creating scarcity of fodder which directly affecting the lives of mountain women: they face shortage of cow dung, the main source of energy thus people resorted to chopping firewood from the forests, which lead to further ecological degradation of rangeland

resources. Climate change has also caused a depletion of forest resources, introduction of cash crops and increased male labor migration, which have affected women adversely by increasing their workload in rural Nepal. They experience unequal treatment based on traditional gender relationships that deprives them from equal access to health, education, property and wellbeing.

2.2. Perception of local people towards climate change

Tiwari (2009) showed that average temperature of Nepal has increased from 0.6 to 0.98⁰C over the last 30 years and precipitation is characterized by large inter-annual variability with substantial decrease in amount over the last five years. More than 80 percent HHs responded that they have perceived increased temperature and expressed low amount snowfall in High Mountain and rainfall in Mid-mountain and Terai region over the last five years that resulted lower availability of grass for livestock and the medicinal plant such as Nirmasi and Jimbu affecting nomad groups. Similarly, more than 75 % respondent explored that monsoon has started one or two weeks later and increased the more number of drought days in the Mid-mountain and Terai. Study found that there was also decreased in water sources, ground water, and increased siltation and sedimentation in the downstream Terai region. Furthermore, changes in flowering and fruiting time in some species, increased invade species like *Ageratum* spp, *Lantana camera* in the farm land as well as forest land. Adaptation measures such as use of water source, community forest management, planting trees and grasses in the farm land, crop diversification were practiced by local people in their farm land as well as communal land. Natural resource degradation and poverty aggravated the negative impacts because small farmers do not have adequate resources to adopt to cope with CC impact.

Dongol. A (2009) studied the perception of the farmer on climate change and adaptation in agriculture in Jiri, Dolakaha district of Nepal. The climatic data were analyzed by using linear regression and questionnaire survey was done. The increasing trend of both temperature and rainfall were observed while the perception of people towards climate change was found to varying. The majority of respondents felt temperature is increasing while rainfall and frost is decreasing.

Tamrakar et al (2010) studied the perceived impacts of climate change on forest and biodiversity and documented the coping strategies in East Nepal and concluded that temperature and rainfall patterns is fluctuating which is supported by the various indicators to perceive climate change and some of the major impacts recorded were forest fires, landslides and floods and invasive species.

2.3. Climate change impacts on other resources and its relation to gender

Household food hierarchies exist (placing females below males), and disasters can reduce the overall amount of food available, exacerbating the unequal position of women. Women are likely to have poorer nutritional status and resistance to disease, and so are likely to be more at risk than men (Blaikie *et al.* 1994).

Wacker (1997) explored the links between gender issues and the effects of environmental change on water resource availability focusing in the Himalayan mountains, as high altitude regions are considered to be particularly affected by the impacts of climate change

Valerie (2002) had clearly illustrated the difference in vulnerabilities women and men face in the support of the fact that more men died than women during Hurricane Mitch. It has been suggested that this was due to existing gender norms in which ideas about masculinity encouraged risky ‚heroic‘ action in a disaster.

Aguilar (2004) revealed that death rate of women was almost five times higher than of men in the cyclone and flood of 1991 in Bangladesh because of only one reason that the warning information was transmitted by men to men but not to women counterparts and in addition they are not allowed to leave the house without a male relative. The majority of victims in Hurricane Katrina were African-American women and their children, a group likely to be poor, lack health care and earn low wages (Gault et al, 2005; Williams et al, 2006) and in Hurricane Mitch, men suffered higher mortality rates because they took more risks trying to save themselves and their families (Bradshaw, 2004). Women, boys and girls are more than 14 times more likely than men to die during a disaster (Peterson, 2007)

According to the IPCC report, increases in global temperature will accelerate glacier melting, resulting in increased water flows for several years. This would be followed by water shortage as glaciers gradually disappear (IPCC, 2007). These fluctuations of water may increase the number of hydrological hazards that occur regularly in high relief regions. Water shortage impacts on every aspect of daily life by reducing the drinkable water supply, affecting agriculture, food production and so livelihoods, aggravating hygiene, sanitary and health conditions, etc .

It is also believed that women and children are 14 times more likely to die than men during disasters (Brody et al. 2008). Masson (2008) explored the links between gender issues and the effects of environmental change on water resource availability.

2.4. Nepal's Response to Climate Change (Policy and practice)

Mitigation and adaptation policies for climate change are under process. Policies are directly and indirectly related with climate change through the program of sustainable forest management, biodiversity conservation, watershed management, water source protection, water harvesting, etc. These policies have envisioned program from its own perspectives. But, most of the policies do not include perspectives from climate change. Thus, these policies and strategies needs further strengthening from context of climate change. In response to Climate Change, Nepal has taken following initiatives (NAPA\MOE, 2009):

- Nepal signed the UNFCCC in Rio de Janeiro in June 1992 and ratified it on 2nd May in 1994. Since then, Nepal has been regularly participating in COPs and other subsidiary meetings.
- It also became party of Kyoto Protocol by submitting its instrument of Accession on September 16, 2005.
- To take advantage of the Clean Development Mechanism (CDM) as a source of new investment and technology, Nepal is trying to develop various CDM projects which promote clean energy and sustainable development in the country. Nepal has recently set up the National Designated Authority (NDA) under the Ministry of Environment to approve CDM projects.
- National Climate Change policy and National Adaptation Program of Action has been formulated.
- The Alternative Energy Promotion Centre, together with several NGOs and private companies,

is promoting clean energy efficiency technologies such as biogas, micro-hydro and solar through subsidies as well as technical assistance.

- Ministry of Environment set up Climate Change Network comprising of representatives of relevant government bodies, NGOs, civil society and experts for information and knowledge management and policy input in 2007.
- From the experiences of the Climate Change Network, the Government has recently constituted the Multi-sectoral Climate Change Initiatives Coordination Committee (MCCICC).

Furthermore, National level disaster relief fund has been working under the chairmanship of the Prime-minister and disaster relief committee has been working under the District administrative office to provide the immediate relief for climate induce disaster. Additionally, Government offices such as (Irrigation office, Soil conservation office, Water induce Disaster office) and some NGO such as Practical action, Red Cross, are also involved at district level climate induce disaster relief activities.

CHAPTER III

METHODOLOGY

3.1. Research Design

The research study used analytical and descriptive design to analyze and to attain the study objectives. The research procedure adopted for the study is presented in a flow chart below.

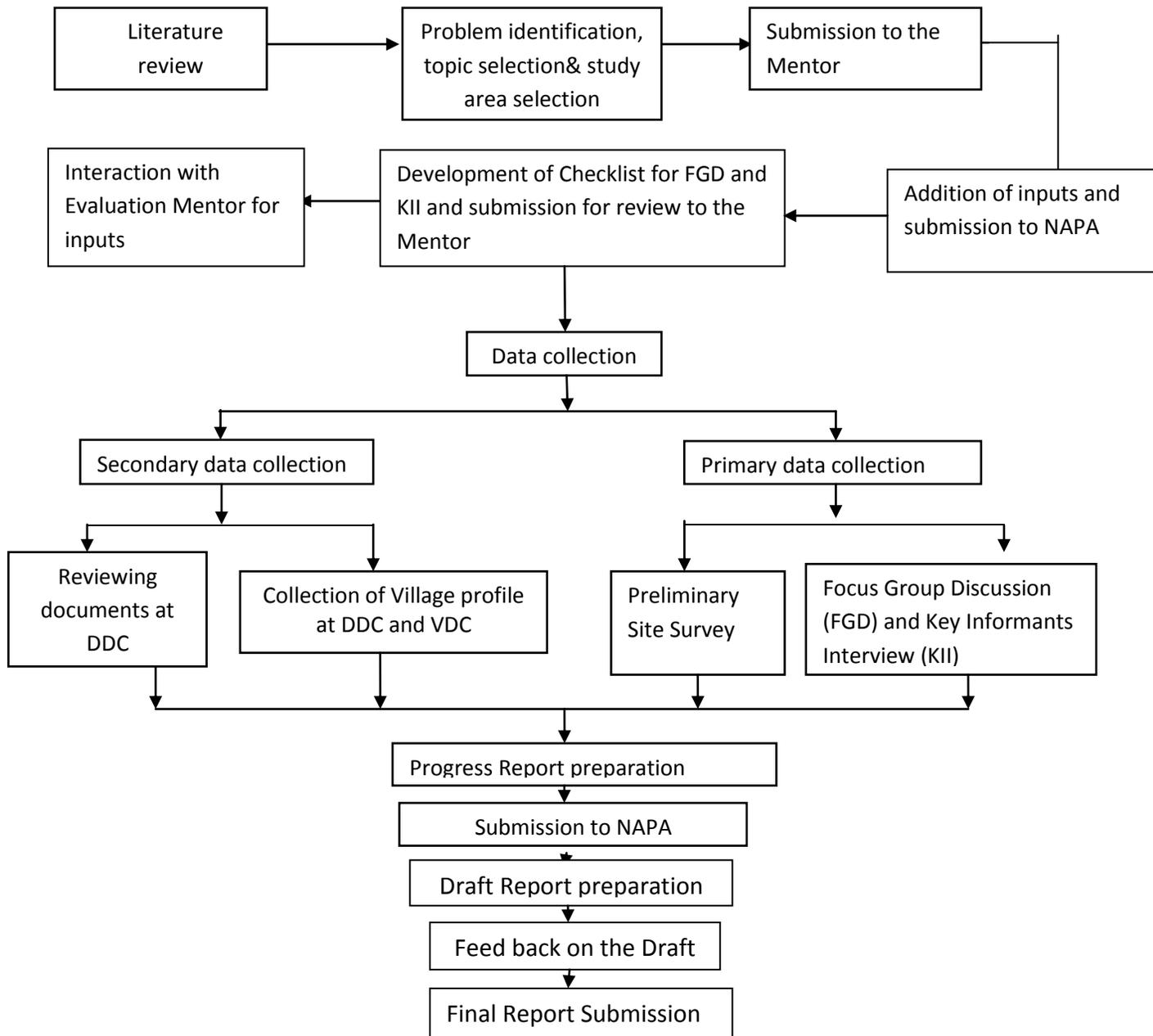


Diagram 1: Flow Chart of Materials and methods adopted in the study

3.2. Data Collection

The principal aim of the data collection was to assess the fuel resources in the study area, establish the likely impact and extent of effects due to climate change on fuel availability, and identify vulnerable groups within the site in order to document adaptive strategies.

3.2.1. Primary Data

Multiple and complementary data collection methods were employed, including focus group discussions and key informant interviews. The field study began on 28th September with a visit to the District Development Centre in order to review the village profile on first day. Local correspondents were then contacted to facilitate interaction with the villagers. The researchers made a couple of visits to the nearest ward, Nibuwater of Siddhi VDC for reconnaissance survey and rapport building with the villagers.

The tentative framework for the data collection can be shown diagrammatically as follows:

Table 1 Framework of Fieldwork

<p>Overall methodology:</p> <ul style="list-style-type: none"> • Qualitative research • Focus groups <ul style="list-style-type: none"> • Social resource mapping • Energy Rapid Assessment • Seasonal calendar • Key informant interviews • Concentrate on rural areas with fuel wood dependent communities <p>Sampling for focus groups:</p> <ul style="list-style-type: none"> • To be relatively homogenous groups • Women/men farmers • Resource user women • Mixed women group – age • Possible mixed women / men group • Mixed men group –age • Vulnerable groups (minority ethnic group, etc.) 	<p>Criteria for selection of areas:</p> <ul style="list-style-type: none"> • Vulnerability • Poverty / relative poverty (according to country guidelines) • Climate change and variability – where impacts are already visible • Areas where subsistence farming & livelihood strategies are dependent on climate – influenced by climate change • Don't include urban areas <p>Sampling for Key Informant:</p> <ul style="list-style-type: none"> • Community / women leaders • Female headed households • Elderly women/men • School teachers • Executives in CFUGs

3.2.1.1. Focus Group Discussion

The focus group discussions were used to ascertain the fuel options, climate change impacts, coping strategies and fuel status of the selected socio-economic groups and the general population with key focus on coping strategies, as well as to discuss hazards and changes in the past twenty five-thirty years and map the Energy Rapid Assessment. The discussions were carried out as follows:

- Teendobhan (Youth, middle age and elderly women FGD)
- Deujar (Middle age men and Middle age women FGD)
- Church (Middle age men and old men only FGD)

The first Focus group discussion (FGD) of women only was carried out on 2nd of October and a couple of Key informant interviews were taken which were continued on the next day at Nibuwatar, ward no.2, Siddhi V.D.C., Chitwan. The FGD was conducted at Teendobhan, and the participants were from three wards of Siddhi V.D.C. The group comprised of eight women, including young, middle aged and old women, from Majhbang-6, Nibuwatar and Teendobhan. A Social resource mapping and Energy Rapid Assessment was also conducted through the group participation.

A mixed group of men-women were called at a community church at Deujar for another focus group discussion. Furthermore, a focus group discussion was carried exclusively with men. The focus group discussion covered the wards 2, 6 and 7 of Siddhi VDC. Some tools used during the FGD were as follows-

- a. Social Resource Mapping
- b. Seasonal calendar
- c. Energy Rapid Assessment

Energy Resource Rapid Assessment

Livelihood resource vulnerability assessment (Regmi.et.al, 2010) has been modified to the Energy resource rapid assessment according to the research objectives. The available energy resources and the likely climatic hazards which may possibly affect those resources were

identified during reconnaissance survey, trend analysis and Social Resource Mapping. Those parameters are used to draw the table 6 . The participants were allowed to rate the impact severity of the climate hazards on the different energy resources. The scores were finalized by the approval of participants on the discussion.

3.2.1.2. Key Informant Interview

The key informant interviews were used to establish trends of climate hazards and to identify common threats. Key informants viz., executive members of the CFUGs, women leader or active in any group, school teachers, elderly people, entrepreneurs, etc. were interviewed. These data sources were supplemented by secondary data sources. Climate hazard trend analysis was done with the key informants.

3.2.2. Secondary Data

Secondary data were collected from NGOs, INGOs and local Government organization, Libraries in AEPC, TU, Practical Action, etc. The available literatures and relevant documents, information, reports, different journals, published and unpublished documents and other relevant literatures available online and from various sources were collected and reviewed thoroughly. Rainfall (1978 to 2009) and temperature data (1980 to 2008) were collected from Department of Hydrology and Meteorology, Government of Nepal. Linear regression was used to test the relationship of Temperature and Rainfall separately over years. The trend line was then fitted to the plot and liner model was used to test the significance.

CHAPTER IV

RESULT AND DISCUSSION

4. 1. Results

The analysis from the KII and FGD showed that people perceive that there has been variation in local climate such as rising temperature, rainfall fluctuations, events of drought and severity as reported by the respondents in the study site. The climatic variability reported by local people was cross-checked with the meteorological data (temperature and rainfall) of about 30 years for the regional station, Rampur.

The study also illustrates that traditional gender based roles still persist. *“The man was and has always been the head of the household. The woman was more active in the kitchen to make sure that the family has something to eat every day. A house without a woman is not a house, although in the past men had more to say and made most of the decisions, nowadays women are becoming involved in decision making and more empowered than in the past”* (A 65 year old female respondent – KII). One middle age male participant from the Deujar village confirmed that by stating: *“Women are regarded as masters who know how to save money, food and other household resources. Women know it best when it comes to well-being of the household”*. Gender roles still exhibit conventional division of labor between men and women in rural settings. These roles and responsibilities are very much linked to the utilization of natural resources (land, water, energy and forestry).

The researchers noted interesting behavior during FGD. The elderly women FGD were passive and less expressive during discussions as compared to middle-age women. The elderly women appear to be content with contemporary gender relations and were not as expressive as the middle age group. Middle age women were free to express their views during discussions citing their dissatisfaction with regard to decision-making processes within their community and workload they have to face. While in the mixed men-women group, women were almost silent listeners and men dominated the discussion.

4.1.1 Climate Change

1. Change in temperature

The mean annual minimum and maximum temperature from 1980 to 2008 observed were 17.6 °C and 30.9 °C respectively. Mean annual minimum and maximum temperature show increasing trend at the linear rate of 0.06°C/year and 0.018°C/year respectively (fig 2) while the mean annual temperature show the increasing trend of 0.39 °C/year (Fig.3).

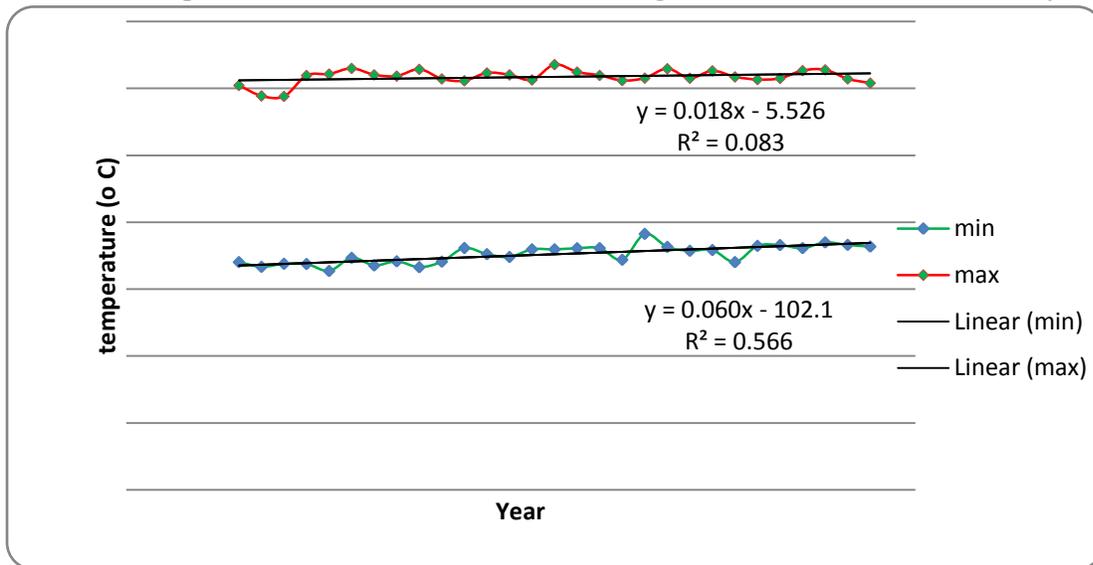


Figure 2: Annual minimum and maximum trend of temperature of regional station (Rampur)

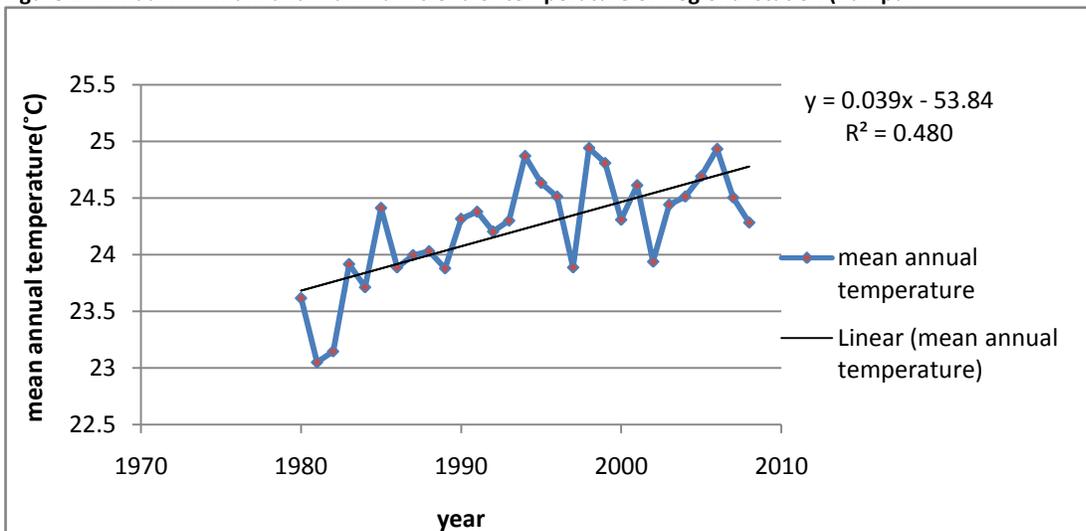


Figure 3: Annual mean temperature trend of regional station (Rampur)

The mean annual minimum temperature shows a strong positive correlation with year ($r=0.75$) whereas mean annual maximum temperature shows a weak positive correlation with year ($r=0.29$). The mean annual temperature shows a strong positive correlation with the year (0.69).

Table 2 Linear Regression statistics of temperature

temperature	R Square	p-value	p-calculated	sig codes
max	0.08	<1	0.12	NS*
min	0.57	<0.001	2.5-E06	***
Mean	0.48	<0.001	3.04-E05	***

*NS=not significant

2. Change in precipitation

The mean annual precipitation from the rainfall data studied from 1978 to 2009 AD is 169.74 mm ($\sigma =28.07$) at Rampur station. The highest monsoon precipitation is 564.5 mm in the year 2007AD. The linear trends of mean annual rainfall, monsoon, pre-monsoon and post-monsoon are all in the line of increasing trend while the trend of winter monsoon is decreasing. Due to the large variation in inter-annual rainfall data 0.931 mm/year rise of mean annual rainfall is statistically insignificant (fig4). Similarly, the rainfall data when separated in different seasonal categories and made a linear trend analysis of all the three categories(pre-monsoon, monsoon and post-monsoon) also show the same increasing trend but was statistically insignificant(fig. 5and 6 and 7 respectively) except winter monsoon rainfall shows decreasing trend (fig 8).

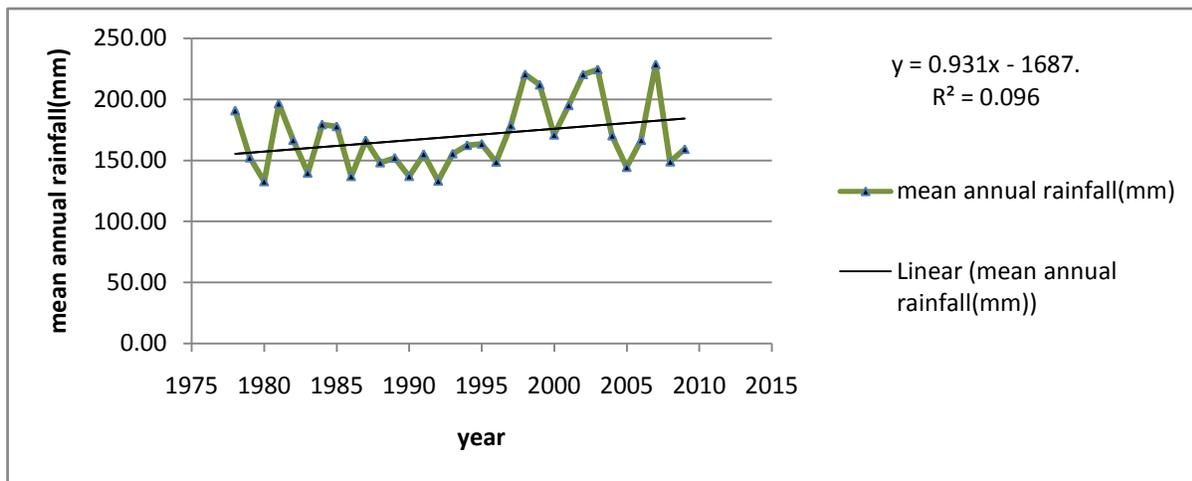


Figure 4: Annual mean rainfall trend of Rampur station

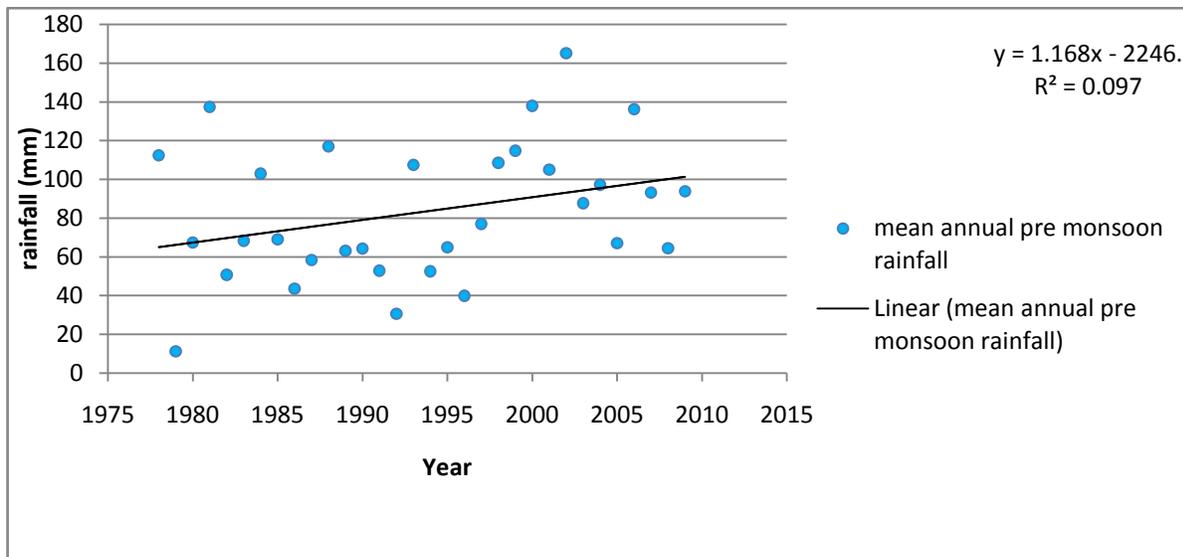


Figure 5: Linear trend of mean annual pre-monsoon rainfall of Rampur station

Linear trend analysis of different seasonal categories of premonsoon, monsoon and post monsoon show the rainfall is linearly increasing in the rate of 1.168mm/year, 1.728 mm/year and 0.459 mm/year respectively which are not statistically significant as shown by table 2 while the winter rainfall trend analysis shows the decreasing trend by 0.052 mm/year as indicated by fig 8.

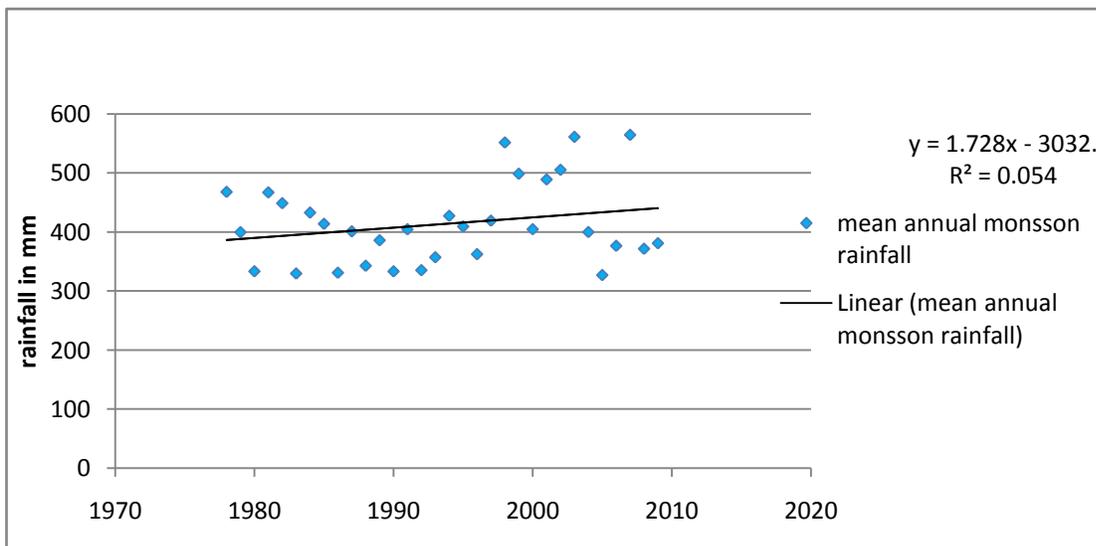


Figure 6: Linear trend of mean annual monsoon rainfall of Rampur station

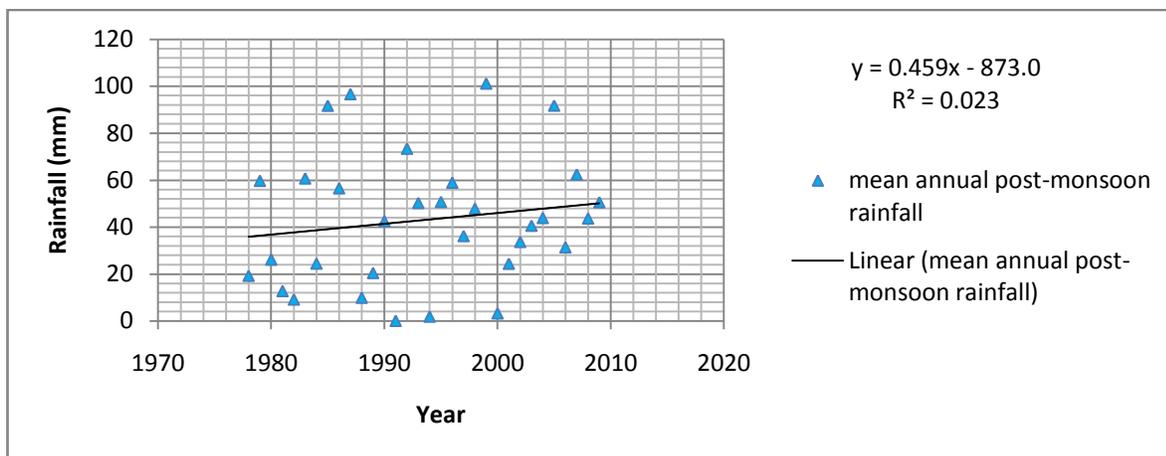


Figure 7: Linear trend of mean annual post-monsoon rainfall of Rampur station

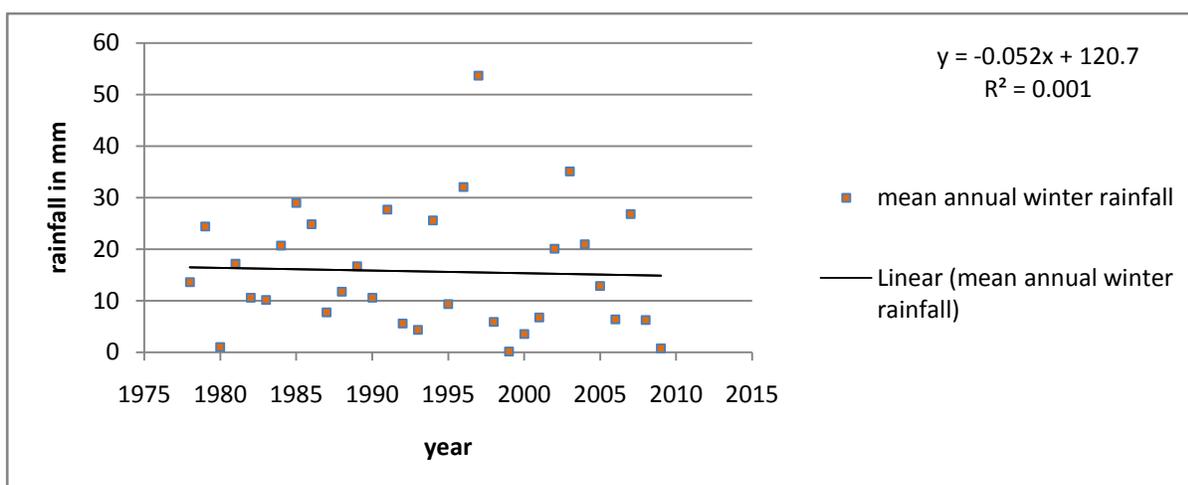


Figure 8: Linear trend of mean annual winter rainfall of Rampur station

Table 3: Linear regression statistics of rainfall

Rainfall	R square	p-value calculated	p-value range	Sig codes
Pre-monsoon	0.09	0.08	<0.1	*
Monsoon	0.05	0.19	<1	NS
Post-monsoon	0.02	0.39	<1	NS
winter	0.001	0.82	<1	NS
Mean	0.09	0.08	<0.1	*

Annual mean rainfall along with pre-monsoon monsoon and post-monsoon show the weaker positive correlation with the year ($r=0.31$; $r= 0.31$; $r=0.23$; $r=0.15$ respectively) and the weaker negative correlation($r=0.04$) is established between winter monsoon rainfall and year data (table 3).

4.1.2. Perception towards Climate change

The study tried to access the knowledge/awareness of the locals on climate change. Due to the formation of community forest user group, level of awareness in the people is very high. Inflow of outside people for research activities and for program launching by several NGOs and INGOs, have made the people inquisitive and concerned about their surrounding environment. Mostly men are actively participating in the community based approaches and are relatively well aware of fresh information. Women generally receive second hand information. More men remember climatic hazards and can present trends than do women. Few women mainly younger ones have heard about the climate change informally and even could explain it as an abnormal phenomenon of weather pattern. In contrary, older women were totally unaware of the term.

Table 4: Local perceptions and observed changes in climatic and environmental conditions over 30 years

Climatic variability	Environmental conditions
Summer getting hotter, winters milder	Invasion of Alien species
Late arrival, early withdrawal of rainfall	Mosquitoes and new insect outbreak
Droughts more frequent	New diseases in crops and livestock
Reduced length of growing period	Irregular dry spells coinciding with critical growing stages of crops and vegetation e.g. delay in flowering of Indian Butter tree
Occurrence of foggy mornings	Fog and mists affecting growth of vegetables like chilly, garlic, potato, etc.
Drying of aquifers	High decrease in fish population in the streams

Source: field study, 2010

The perception of people including both gender inclined positively towards climate change. Local people responded based on their past experience that warming days, erratic rainfall patterns, invasion of alien species, emergence of new pest and diseases and their adverse effects on human beings have increased. More than 80% respondents agreed to that number of warm days are increasing, rainfall pattern has become more unpredictable, seasons may have been changing, frequency of drought has increased, natural water sources are drying, early onset of

foggy mornings, change in flowering and fruiting time (Indian butter nut tree and cereal crops) are changing, invasion of new plant species such as Banmasa (*Mikania macarantha*), Kalo banmara (*Eupatorium adenophora*), Banmara (*Lantana camera*), etc. are found in abundance even at these hilly terrains. Additionally, there was decreased fish availability in the stream. Furthermore, local people reported expansion of river channel and increased sedimentation.

Table 5: History of climatic events as reported by respondents (Climatic hazard trend analysis)

1974	Severe flood, landslide and famine observed
1983	Flood of small magnitude
1988	Flood damaged the crop in the floodplains
1993	Flood created havoc by displacing settlements and crop fields in the plains while large scale landslides observed in the hills
2003	Flood swept farmlands along the plains
1993-2004	Occasional forest fire
2006	Known as drought year

Source: field study, 2010

Table 5 shows the result of climatic hazard trend analysis which is based on the experiences shared by key informants. These are the extreme events and may or may not comply with the exact meteorological data.

4.1.3. Impacts of climate change in general

According to the FGD and KII, direct impacts have been reported on agricultural productivity and biodiversity whereas indirect effects have been seen on resource availability and energy consumption and hence livelihood. The impacts are discussed in elaboration below.

1. Agriculture: The impacts on agriculture due to the prevalent increasing temperature and rainfall were visible to community of the study site. Agriculture is the main source of livelihood though community had a problem of food insecurity for almost 6 months. Weaving of baskets, livestock rearing and selling butter of Indian butter nut tree (*Bassia butyracea*. Roxb.) seeds are other sources of income. The main crops are maize, millet, and pulses. Most of the women believed that the weather pattern is unpredictable so the yielding is unpredictable accordingly. Summer rainfall has shifted from June- September and is prolonged to October- November and

has a great impact on rice farming. Some of them also stressed that they are coping the less productivity by using the chemical fertilizer and pesticides, however, most of them disagreed that they are using chemical fertilizer.

2. *Biodiversity*: A majority of women felt that the tiger (*Panthera tigris*), sloth bear (*Melursus ursinus*), fox (*Vulpes bengalensis*) and ghoral (*Naemorhedus goral*) are a rare sight in the nearby forest. While the male counterparts pointed out that the number of monkeys semlo is increasing. Peacocks (*Pavo cristaus*), Bulbul (*Pycnonotus cafer*) and Pheasant (*Lophura leucomelana*) are also rarely seen in the jungle than before.

i. *Invasion of alien species*: Several participants in discussion reported that the alien species like *Eupatorium adenophorum*, *Mikania macarantha*, etc. have been observed in the community forest even in this high elevation. Some of them shared the experience of using *Eupatorium adenophorum* as a bio-fertilizer as much as possible in order to consume the weed.

ii. *Incidence of pests and diseases*: Several women experienced the incidences of pests and diseases infestation since few years back, since they handle much of the farm works.

a) Crop: Rice plants were infested with disease on leaves recently while the tradition of planting rice was adapted from 30 to 35 years. They do not use chemical fertilizer but are using pesticides as a resistance to disease.

b) Livestock: Several women participants agreed that a kind of disease on fowl in which feather loss is new here and is probably due to the temperature fluctuations.

4.1.4. Study Context

Impacts on Energy resources

The focus group discussion revealed that firewood is the focal source of household energy and is mainly used for cooking, animal feed processing and room heating. Agro waste is only the subsidiary energy source for cooking purpose. The national gridline of electricity has been supplying electricity to Nibuwater and Majhbang of Sidhi since a year ago and is used for lighting purpose only. Most of the residents have migrated from hilly parts of Sidhi due to the day to day drudgery of collecting firewood. Several women felt that the establishment of

community forest has increased the accessibility and availability of firewood though the access has been restricted to a certain day when the CF is open for fuel wood and fodder collection. The male participants agreed. The impact of climate change on energy access and availability has till now been insignificant due to abundant supply from CF. The major impacts on energy resources can be summarized as:

- **Biomass:** The abundant availability of the firewood from the community forest has not made as such any tangible impact on the biomass sector for cooking and other household chores that needs firewood. . However, some women recalled that previously when forests were not managed by community, they travelled longer distance for fetching firewood. Women participants during FGD felt that the intervention of Improved Cooking Stoves (ICS) in few houses, though negligible, has set the example of consuming less firewood than the traditional stove like tripod stove (*Odan*).

Men do not contribute to indoor chores like cooking and visit forest less often than women for fuel wood, nevertheless they agreed with women. But, the cause for fuel wood becoming less available might also be attributed to probable increase in population over years as well as the slash and burn agriculture practice of Chepangs rather than climatic variability alone.

- **Water based energy resources:** In Sidhi VDC, water power is the energy resource for : a) running water mills and b) rotating turbine in pico-hydro.

a) **Water mills:** There are two water mills in Siddhi, out of which only one is functional. The focus group participants felt it could be due to the low stream discharge that is responsible for driving the water mill. According to the respondents, water on the stream used to dry only for two months (January to February) but nowadays it dries for 7 months (from October to May) and therefore they have to go to another ward of the same village for grinding maize or other agro-products during the dry season. These local opinions could not be cross checked as data on discharge of Deujar, Pamarang or Majhbang are unavailable, them being small streams feeding to second order river Kayar.

b) Pico-hydro: Stream water of Deujar drives the turbine of the pico- hydro (3kilo Watt) that electrifies sixty households in Siddhi (DDC Chitwan). The local respondents do not feel that impacts of climatic variability have been observed on pico-hydro. Though the

pico-hydro was installed about five years ago, it has remained closed due to technical problems since six-seven months.

Ward 2 and ward 6 of Siddhi are connected to the national grid, however electric current flows for limited hours and hence is insufficient even for lighting purpose.

- **Solar energy:** Solar energy is used to charge a 3Watt solar photo voltaic panel that lights a solar lamp, popularly called “Solar Tuki” consisting bulbs of white light emitting diodes. In Siddhi, eighty four households benefit from this form of lighting and have replaced traditional kerosene wicked lamps in night hours (DDC Chitwan). Local respondents are of the opinion that technical problems and high initial cost rather than climatic variability has hindered them from tapping this free form of energy from sun.
- **Petroleum products:** Unlike the other wards in Siddhi, Ward 2, which is in plain land, is the only ward that has (feeder) road access to markets in Tandi and Bharatpur. Occasional vehicles like tractors or jeeps that run to and from Shaktikhor, kerosene wicked lamps and only one consumer of Liquid Petroleum Gas (LPG) account to total petroleum consumption in Siddhi. These energy demands are fulfilled by imported fossil fuels and have no direct effects of climate change

Table 6: Energy Rapid Assessment

Energy Resources	Rain High/ Low	Summer heat Increased/ decreased	River flood	Forest fire
Biomass				
-fuel wood	3	0	2	4
-Agri residue	0			0
Solar	2	1	0	0
Water based energy	4	2	4	2
Petroleum products	1	0	2	0

(0-No impact on the Resources;1- Low impact on the Resources;2-Medium impact on the Resources;3-High impact on the Resources;4-Very high impact on the Resources)

Source: Modified from the “A community based tool kit for practioners”(LFP,2010)

Local people have ranked water based energy resources as the severely affected as shown in the table 5, as they explain that erratic rainfall pattern has greatly affected stream discharge which consequently affects hydro based energy, particularly Pico-hydro and water milling in the study site. Biomass is the next category of energy resources the respondents have ranked as the second most affected energy resources by climatic variability like forest fire, drought and increased temperature. However, any incidences of increase in frequency of forest fire in the study area have not been backed by meteorological data.

4.1.5. Roles and responsibility related to energy sector: Obviously, women are more responsible for cooking purpose than male member of the family so they are more prone to indoor air pollution while for the collection of firewood women are being helped by the male members of the family as well. Male contribution is more often than not limited to chipping logs or helping to carry heavy logs. Male are responsible for the maintenance and other technical part of alternative energy options like hydropower, solar, water mill, etc.

4.1.6. Participation in trainings in energy sector: Some women participated in the discussion told that two women of the village got the training of ICS but the knowledge was not implemented further to other women. Though the target group should have been women, the participants were mostly male.

4.1.7. Gender exclusive problems related to energy

Women have a cumbersome role to play in a Nepalese society especially in remote rural areas. Women do not have any excuse or break from daily chores be it rain or shine. Women work alike no matter what their health state is. Women carry heavy loads of fuel wood or water pots even in the final days of their pregnancy and just after giving birth in addition to their daily household chores. Many women have lost their lives due to Uterine prolapse and several still pulling along with pain. Many women are physically disabled due to accidents during fetching fuel wood and fodder. Specifically, due to climatic calamities, among the casualty generally, it is the women, old and the children that are victims. Several women have died in floods and landslide when they go out for fuel collection.

Women in the community generally do not own land and have hardly any rights regarding the management of natural resources, despite often working in the fields. The power of the male landowners over the natural resources means that the poorest groups, in particular women, are doubly excluded – from both the land and its resources – and are thus more vulnerable in coping at times of natural calamities due to climate change.

Men have reported attack by wild animals during fuel fetching and cattle herding. Apart from that men usually face psychological and economic loss in the form of their spouse or property and kinds.

4.1.8. Adaptation to Climate Variability:

This section draws on climate change adaptation strategies Chepang communities in the study site have taken in response to extreme weather events. The Chepangs seem to have adopted the anticipatory adaptation strategies as it involves advance preparation for the consequences of change. For example, adoption of alternative energy technologies, community forest management and traditional stocking of fuel wood.

a) Use of forest resources as an adaptive strategy

Households utilize forest resources in their daily livelihood activities (e.g., wood for fuel consumption) and for Chepangs as a coping strategy in extreme events (e.g., foods during famine). Chepang traditional storage skills of fuel wood stock by sheltering it with *Varlo* (*Bauhinia* sp.) leaves have long been used for coping fuel wood shortage. Besides, local people have been managing community forest since 1995 in Siddhi. In total there are five Community Forests (CFs) namely: Indreni (ward 1 & 6), Deujar (ward 7), Bhattauli (ward 8 & 9), Nibuwatar (ward 2) and Chitram Kaminchuli (ward 5) within Siddhi. Though not envisioned to cope climate change initially; the CFs may have increased the resilience of community by fulfilling the demand of forest products and minimized shifting cultivation from indigenous communities (Chepang).

b) Optimum use of Agricultural farms as an adaptive strategy

As an anticipatory or reactive adaptive strategy, Chepangs have started practice of planting biomass yielding plants on their kitchen garden (bari land) and farm land. Similarly, due to awareness or external assistance, some Chepang communities have started tree plantation in the surrounding areas that are provided by the NGOs, e.g. *Ipil ipil* (White leadtree), *Melia azedarach* (Persian lilac), etc. Such trees not only assist to fulfill the firewood demand but also the fodder need of the villagers.

c) Use of Alternative energy resources as an adaptive strategy

Adoption of alternative energy resources are anticipatory adaptive strategies employed in Siddhi VDC that relies primarily on biomass for energy means. Introduction of alternative energy options is relatively new. However, transformation has been significant as two wards; Majhbang and Nibuwater receive electricity from the national grid extended from Shaktikhor while a total of sixty households enjoy the benefits from pico-hydro generated from their local stream Deujar (3kW). Similarly, eighty four households have solar panel lighting system throughout Siddhi, while two biogas plants and two Improved cook stoves are installed in Majhbang.

d) Migration as an adaptive strategy

Migration can be an anticipatory or reactive strategy. Most of the residents have migrated from hilly parts of Siddhi to the lowlands due to the day to day drudgery of collecting firewood. People have moved to market places that have easy access to natural resources, opportunities and less hazardous areas, like Shaktikhor and lowlands of Siddhi.

4.2. Discussion

Change in temperature linking with perception

The study based on the data from 1975 to 2005 shows the mean temperature of the Nepal is increasing steadily at the linear rate of $0.04^{\circ}\text{C}/\text{year}$ (Baidya et.al 2007). Koirala.et.al (2010) concluded that there is a marked variation in temperature i.e increase in average temperature by 0.4°C in 14 years in Taplejung district and 2.9°C in Khotang district in the duration of 19

years. The increasing rate of mean annual temperature of the study site i.e. $0.039^{\circ}\text{C}/\text{year}$ is more or less equal to the national increasing rate of the temperature but is higher than the global average increase given by IPCC (2007). Both of the minimum and maximum temperature as shown in the fig 1 shows the increasing trend of the temperature, however the increasing rate of the winter season ($0.06^{\circ}\text{C}/\text{year}$) is more rapid than that of the summer season ($0.018^{\circ}\text{C}/\text{year}$). According to Tiwari et. al. (2009), average seasonal temperature data analysis showed more prominent rising of temperature in winter ranges from 0.05°C in Middle Mountain to 0.02°C in Terai region yr^{-1} which clearly indicates the warming trend in winter is more as compared to summer seasons. The rate of warming is also variable, which is higher in winter compared to the other seasons (Baidya et. al 2007). The similar case was found in the study site as well i.e. warming trend of winter season is more than that of the summer season. The statistical evidence from meteorological data as discussed earlier makes a sense as the similar experience has been perceived by the respondents such as hotter summer and milder winter. The warming trend of the temperature is also supported by the increase in mosquitoes and the invasion of new kind of weeds.

Change in rainfall linking with perception

The study (Baidya et. al 2007) concluded that the frequency of heavy precipitation events has increased, consistent with warming and the number of rainy days ($\geq 1\text{ mm}/\text{day}$) shows a decreasing trend and the heavy precipitation events with the number of rainy days ($\geq 100\text{ mm}/\text{day}$) show the rising trend in Nepal. It was necessary to know the number of rainfall days of the study site that could have given a more clear picture to establish the relation between the rainfall trend and the people's perception. However, the erratic inter-annual variation observed in the mean annual rainfall (fig 4) in recent decade suggests that the heavy precipitation events have been occurring in recent decade in comparison to previous decades. This shows that the people experience few days of rainfall though the intensity may have increased. Hence, it is possible that they can give a response that the rainfall is being decreased.

As for rainfall data, it do not show statistically significant trends (fig. 6, 7 and 8) except that of annual mean rainfall and mean of pre-monsoon rainfall data (fig 4 and 5) due to the inter-annual

variation as discussed earlier. Respondents can remember the extreme events regarding rainfall like flood and drought (table 5). Therefore the variation in rainfall data and the people's experience comply with each other. The experiences of respondents saying that the rainfall is being decreased do not agree well with the trend analysis of mean annual rainfall data. It is possible because of some extreme rainfall in the year 1998, 1999, 2002, 2003 and 2007 and eventually decreasing pattern in recent years. It is likely that, people are influenced by the rainfall of these extreme events and therefore they may have drawn conclusion that the rainfall has been decreasing. If the trend line is established without these extreme rainfall data, the rainfall is in decreasing trend.

Impacts on Energy resources and adaptation measures

The impacts of climate change on energy resource availability and accessibility is an indirect approach and thus little complex to relate. However, we can simplify it by the fact that the climatic variability in the temperature and precipitation affects the energy resources such as, biomass, solar and water related energy resource. Biomass, the primary source of which is available forest, is a main source of household energy in the study site. Countries in temperate and tropical Asia are more likely to have increased exposure to extreme events, including forest die-back and increased fire risk, typhoons and tropical storms, floods and landslide, and severe vector-borne diseases. Climate change has serious impacts on the health of forest because temperatures rise, weather patterns and the availability of water also change, thus putting more stress on trees for their survival (Dahal et. al, 2009). It is anticipated that climate change will result in aridification, decreased runoff, increased air temperatures and increased extreme weather conditions such as floods, droughts and high winds (Anneck, 2002). The recent study revealed that before the establishment of the community forest, people were facing the hardship for the availability of the fuel wood. According to the experience of respondents the extreme events like landslides they faced made them go through the scarcity of fuel wood because of inaccessibility of the reachable forest. The torrent rainfall day that may increase due to the effect of climate change is another hurdle that made the forest source inaccessible for the people residing in the study site.

The agricultural production is influenced by the number of environmental and non environmental factors (Nayaju *et al.* 2004). The respondents reported the floods and drought and various diseases they have been facing have decreased the productivity of agriculture products and hence agri-residues. Hence another source of fuel likely to replace fuel wood on the fuel wood scarce days are also being decreased. The decreasing agricultural productivity as reported by the respondents is likely to affect their livelihood which probably makes them adopt the easy way of earning like selling of firewood illegally that may in turn affect the available energy resource. The invasion of noxious weeds and alien species like *Eupatorium adenophorum*, *Mikania macarantha*, etc observed in the study site is likely to harm the availability of the firewood species of the study site.

The sustainable forest management by the community, training in various awareness programs by the NGOs, interventions of ICS program, migration from upper hill to foothills is some of the adjustments people have made to cope up with the fuel wood unavailability and inaccessibility.

In Mountain and Siwalik region, local people have been managing forest as a community forest, which may increase the resilience of community by fulfilling the demand of forest products and minimized shifting cultivation from indigenous communities (Chepang) in Siwalik region (Tiwari. *et.al*, 2009).

One of the water mill in the study site was reported to be closed because of the extended dry period in the recent years. The extended dry period made farmers to channelize the water in the field that consequently affect the time of running the water mill. Walking longer distance to reach another water mill and using stone-grinder manually are the adaptations they made. The impacts on other resources available like solar energy, Pico-hydro were reported to have technical problems and were not operated carefully because of less know-how.

Gender differences in energy resource impacts and information access

Sherpa. Y. (2009) conducted the case study on Upper Mustang and Olangchung area which showed that with changes in climate, fuel energy becomes scarce, resulting in a direct increase in women's workload. The recent study conducted in the Siddhi VDC also reported that the community residing in the study site is fuel wood dependent and most of the responsibilities regarding the collection and management of fuel wood rest upon female counterpart that make them more vulnerable to the possible impacts on biomass energy resource due to climate change.

However, the community forest management and optimum utilization of available lands by planting fodder and fuel wood species trees has made the community resilient towards the possible impacts. The seasonal closing of the operation of watermill due to extended dry period have affected both of men and women as both of them more or less participate in the milling and grinding of grains. Both of them consequently walk longer distance to other mills and have to work manually in stone-grinds. These shortfalls are directly increasing young and adult female's workloads, thus, limiting their opportunities to branch out into other activities like education or skill development for employment further making them vulnerable to climate change.

The study showed that besides the gender differences in the impacts imposed by climate change, the prevailing social practices have a gender differences in the energy access information. In the study site, female counterparts have lesser involvement in trainings regarding the alternative energy, higher work load, lesser communication and lesser mobility to market place of women make them less adaptive towards likely impacts of climate change.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

This study found that locals were able to recognize that temperatures have increased and there has been a fluctuation in the rainfall pattern. Peoples' perceptions of variability in temperature over 30 years were in line with climatic data records. However, the locals had reported that rainfall is decreasing over last 30 years but rainfall data recorded by Rampur station shows otherwise. The rainfall data of 30 years demonstrate increasing trend as is shown by figure 2 and 3. Inadequate scientific monitoring like total annual rainy days and stream discharge data makes it difficult to further validate the observed changes.

Variations in temperature and precipitation patterns have impacts on various aspects of local life. Natural resource degradation and poverty are already severe problems in Nepal, and there will be more severe problems in future if present scenario continues, particularly, as poor farmers do not have adequate resources to adapt to climate change. Following conclusions can be drawn from the present study.

- The Linear regression analysis of rainfall and temperature of the study area (Regional station: Rampur) showed annual mean temperature and rainfall is soaring up over thirty years. However, the increase in temperature is statistically significant but insignificant in case of rainfall.
- Local people perceived warmer days, earlier foggy days, decreased rainfall, increased frequency of flood and landslides, shifts in seasonal flowering and fruiting of Indian butter tree as the indicators of climatic variability and viewed reduced stream discharge as the precursor of its impacts on water mills utility in the study site. Supplementary data on stream discharge and total annual rainy days would have been central to cross check the people's perception.

- The Energy Rapid Assessment has shown that the people in the study site, Siddhi are not significantly impacted as far as climate change risk on energy is concerned. It might be because their effort of forming community forest has become a successful coping strategy as the community forest provides more than sufficient fuel for the sparsely populated villages. The replenishment being surplus to withdrawal, any probable loss due to climate change has not been hence noted.
- Traditional ethnic practices long been observed in Chepangs like stocking fuel wood and sheltering them from moisture and rain with sewn leaves of Varlo (*Bauhinia sp.*) as well as recent practice of Community forest management and planting trees like *Ipil ipil*, *Melia azedarach* in farmlands along with crops have served as anticipatory adaptive strategies for coping with consequences of climatic variability on biomass energy resources. Similarly, as anticipatory adaptive strategy, adoption of alternative energy technologies like Pico-hydro, solar energy, water mills has helped to curb dependence on traditional biomass fuels. Additional technologies like improved cook stove might be recommended in the study site to increase fuel efficiency and hence reduce fuel wood consumption.
- It was drawn from the study that access to information or energy resource management responsibilities is enjoyed by men alone even though women have major role in labor related to energy utilization.

5.2. Recommendations

Following recommendations are made based on the research study:

- Further collection of quantitative data, based on a locally representative sample, including river discharge, number of annual rainfall days should be done.
- Complementary qualitative data that track behavioral changes over time in response to climatic events should also be collected to enhance interpretation of the quantitative data.
- Encouraging alternative energy interventions like ICS and solar home systems and regular monitoring for the effective management and application of these would be helpful in preparing locals for the climate change risks in energy availability.

- Inclusion of women in training regarding technical aspects of alternative energy should be encouraged by the concerned stakeholders.
- Income diversification utilizing the local resources like butter seeds viz; making soaps, butter, honey or farming of NTFPs should be encouraged.
- Transportation access is highly recommended.

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ANNEX I (Photo Plates)

Gender Roles



Plate 1: A woman carrying biomass for fuel



Plate 2: A man chipping log



Plate 3: A girl fetching water



Plate 5: A boy showing his fish catch

Percieved Impacts



Plate 5: Diseased paddy plant



Plate 6: Insect infested paddy plant



Plate 7: Invasive alien species



Plate 8: *Mikania macarantha* invasion

Alternative Energy Intervention



Plate 9: Solar LED Lamps



Plate 10: Solar panel



Plate 11: Water mill

Chepong Tradition



Plate 12: Slash and burn agriculture

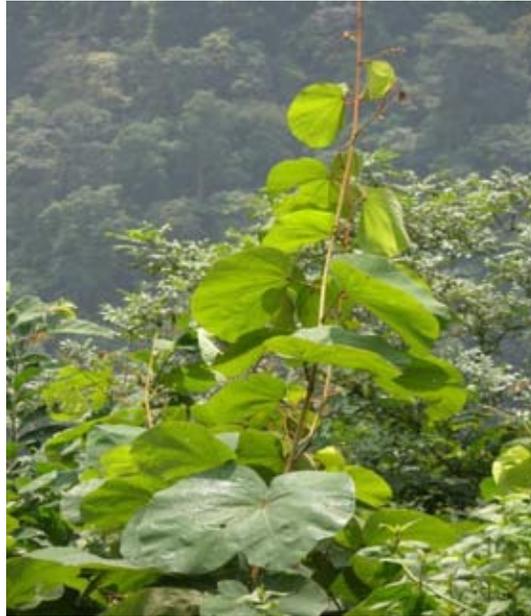


Plate 13: *Bauhinia sp.* (Varlo) leaves

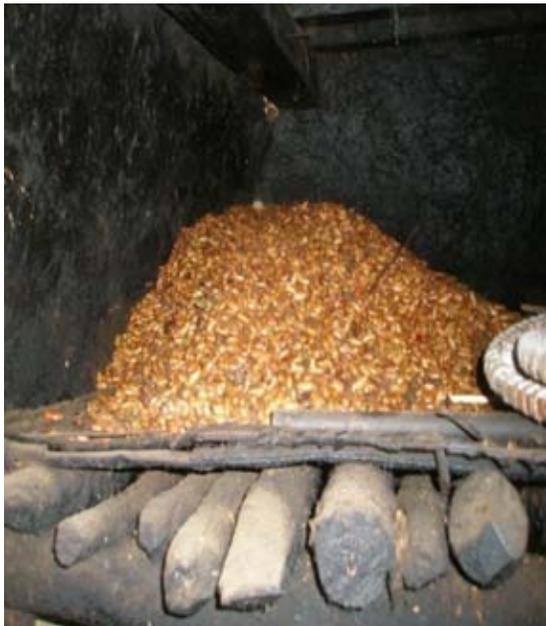


Plate 14: Butter nut seeds



Plate 15: Pressing butter nut seeds for ghee extraction

Interaction with Locals



ANNEX II

Checklists

Key Objective-2

Assessing perspective of rural women in climate change risk and its impacts on energy consumption and availability

Questions:

Perception on Climate change

- Have you heard about climate change? Yes No
- If yes, then what do you mean by climate change?

Observation of climate change in the natural environment (weather, flora and fauna)

- Have you experienced any change or deviation in the weather parameters over the past 10 years?
- Have you noticed changes in the following weather conditions?

Weather	increased	decreased	No change	Don't know	comments
Temperature levels					
intensity of rainfall					
Freq. of rainfall					
Landslide/flooding- severity					
Landslide/flooding- frequency					
Drought- length and severity					
Drought- frequency					
Hailstorm- amount and severity					
March/April cold spell- amount and severity					
Sept/Oct cold spell- amount and severity					
Cloudy weather					

- Have you noticed changes in timing of weather patterns?

Weather patterns	Earlier	later	No change	Don't know	comments
Timing of summer rainfall					
Timing of winter rainfall					
Timing of Hailstorms					
Other					

- Consequences of Climate change experienced?
E.g.: Forest fire, Decreased agricultural productivity, incidences of pests and diseases

- Have you noticed any changes occurring to the local wildlife and vegetation?
e.g.
 - ✓ Changes in timing of bird migration
 - ✓ Extinction of species
 - ✓ Reduction/increase in plant or wildlife species
 - ✓ Changes in timing of flowering /growth cycles?

Key Objective-4

Energy resource

Assessing gender differences in energy access information

Questions:

- What are the priority sectors that needs energy for you (women and men)?
Cooking, animal feeding, room heating, milling grinding, entertainment, street lighting for safety, transportation,

- What are the available sources of energy in this village?
- Amount of fuel used for the following purposes

Service/Device	Firewood	Agro waste	Animal waste	charcoal	kerosene	battery	others
Cooking							
Water heating							
Room heating							
Animal feed processing							
Grinding/milling							
Lighting							

- Who (men/women) uses, and who controls energy sources, technologies and services used?
- Gender bias in carbon emissions?(if possible)
- Difference and access to resources
 - physical- land
 - social- network
 - financial- income-generating works and credit

Cooking

Firewood

- What are the sources of Firewood?
- Who collects them?
- How far do you have to travel to collect them?

- Is there any difference for the collection before and now?(energy shortage, distances, CFUG policy and others)
- If yes, what are the causes of the differences in each cases?
- Who stores them? How?
- What species of firewood you use the most?
- Alternatives: Agri residue, Dung cake,

Impacts on energy sector due to cc

Has there been any difference/shortage in the energy availability 10 years back and now? If Yes, what might be the reasons?

Impact of drought in hydropower if any

Impact of landslide/flood/forest fire in energy access and availability

Impact on availability of Agriculture residue

Key objective-1

Questions: Gender Risk

- What are the obstacles you have to face while collecting the firewood?
(wild animals, management, fear of harassment and sexual assault., accidents, disaster, river,)
- Effects on education of school-girls?
- Lack of Care to sick, old and children?
- Time shortage to other income-generating work like Agriculture, off-farm works?
- Problems associated with cooking and lighting habits
-indoor smoke

Key Objective:3

Documenting the adaptive measures and practices i.e. relevant local and traditional knowledge

How are you managing energy requirements (purpose wise like cooking, animal food processing, lighting room heating)? Is the current practice covering the energy shortage?

Any Energy saving techniques or Physical infrastructure?

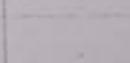
What other sources could be utilized in the future? What energy technologies and services do people themselves see as possible solutions to improve their lives?

How have you coped with the lesser energy available?(Indigenous Knowledge)

Annex III List of participants

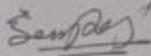
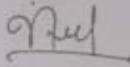
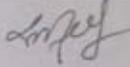
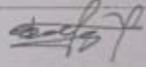
मिति-२०२०/०५/२३

महिला समूह

क्र.स.	सहभागीको नाम	ठेगाना	उमेर	हस्ताक्षर
1	१) गोकुल शर्मा -नेपाङ्ग	त्रिभुवन नगर, जयपूर सुन्दरी गाउँपालिका	२२	शर्मा गोकुल
2	२) पुष्पा शर्मा -नेपाङ्ग	...	३२	पुष्पा शर्मा
4	३) रानी शर्मा -नेपाङ्ग	...	५४	
	४) प्रेम शर्मा -नेपाङ्ग	...	३३	
5	५) दाली शर्मा -नेपाङ्ग	...	२२	
	६) राम शर्मा -नेपाङ्ग	...	२९	
6	७) सुनील शर्मा -नेपाङ्ग	...	२६	
3	८) अम्बिका शर्मा -नेपाङ्ग	...	४२	शर्मा अम्बिका
	९) वासुदेव शर्मा	त्रिभुवन नगर, जयपूर सुन्दरी गाउँपालिका	२४	

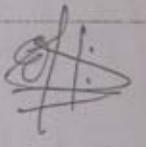
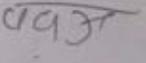
मिति: - २०६७/६/२५

पुरुष समूह

क.स.	सहभागीको नाम	ठेगाना	उमेर	हस्ताक्षर
1	सुशुभ गेपाङ्गु	सिद्धि रिडवाण	२७	
2	भीम दा: चेपाङ	सिद्धि र मजपाङ	६२	
3	अरु लाल चेपाङ	सिद्धि र मजपाङ	५३	
4	सुभाष लाल चेपाङ	सिद्धि र मजपाङ	३६	
5	कुल वडाङ उडा	सिद्धि र मजपाङ	४५	

मिति- २०६७/६/२७

महिला-पुरुष समूह

क्र.स.	सहभागीको नाम	ठेगाना	उमेर	हस्ताक्षर
१	सखीना मराठा	देउजर, सिङ्गी-७	३९	
२	डिप कुमारी प्रजा	देउजर	२३	
३	सुर्षा वाएडुल प्रजा	देउजर	२५	
४	धन वहाडुर प्रजा	देउजर	३६	
५	वपम वाएडुल	देउजर	४०	
६	दिल कुमार प्रजा	देउजर	६५	
७	दानु कथा प्रजा	देउजर	३९	

Annex IV Seasonal Calendar and Social Resource Mapping

