

Study Report

On

Risk Assessment of Local Development Plans with a Climate Lens

(Final Report)

Submitted to

WWF- Nepal

Baluwatar Kathmandu

Submitted by

Youth Network for Social and Environmental Development (YONSED)

Mheipy-16, Kathmandu

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Executive Summary

Climate change impacts are high in the country like Nepal where there are resource options for impacts mitigation. Climate change has led to significant change in precipitation, temperature and other climatic parameters which significantly affects the biophysical and socioeconomic conditions. Rainfall has become erratic and the overall temperature is increasing despite negative trends. Therefore, adaptation to climate change must be a priority for the country.

During the past few decades country has been experiencing significant increase in temperature and warming resulting into climate change. Climate change is happening and it is affecting every corner of the world. However, there is more general information available on Climate Change and its impact. Local communities have observed increased temperature patterns, as well as decrease in precipitation pattern throughout the year and cause heavy soil erosion, river cutting and drought as major hazard aggravated due to climate change. Due to these changes water availability and agriculture productivity have also been severely affected. The proper dissemination of knowledge and information on changing climate and awareness at community is necessary to build up the adaptation practice gradually. In this context, WWF Nepal has taken initiative on climate change adaptation and mitigation practice. This “community based integrating climate SMART’ responses” has been carried out for the preparation of responses to climate change as well as analyzing the problems and take action for its remedy.

The study was conducted in two VDCs of Rasuwa, which are Bhorle and Ramche. The results of the study were obtained from questionnaire survey, FGD and KII as well as using the secondary and ancillary data. Community perception on changing climate was incorporated and obtained through questionnaire survey as well as Focal Group Discussion. The temperature and precipitation analysis of nearby VDC of Ramche and Bhorle was used for the comparative study of climatic phenomena. According to the opinion of community as received from questionnaire survey and FGD Observations of seasonal variation at different part of the VDCs resulted high rainfall regions and seasons recording increases in precipitation and becoming

wetter, whereas low rainfall regions and seasons are recording decreases in precipitation and becoming drier.

The most affected areas in each study sites are mapped after consulting the local community. This mapping could be useful for disaster preparedness programs as well as to analyze changing climatic phenomena and designing future awareness activities with preventive measures. Maximum no. of respondents responded that the deforestation and extreme weather patterns were the major problem for this area. It clearly reveals that the habitants of the study area still lack awareness on climate change.

The community gave suggestions/recommendations to government organizations, local organizations and non-governmental organizations to conduct frequent, workshops, interaction and talk programmes pertaining to climate change should be carried out at local and district level to exchange the ideas and information. It fills the gap among the concerned organizations stakeholders and the community peoples. There is a need for instant and proper dissemination of information. Indigenous methods and knowledge should be promoted while developing and implementing coping and adaptation strategies as to climate change locally.

The government should be responsible for formation of appropriate policy and allotment of budget for climate change mitigation. The community suggested to INGOs/NGOs/CBOs to work out in implementing awareness activities at community level. Moreover, an adaptation plan should be brought forward that would help to sharing experiences, obstacles and bring about positive initiatives within the communities and developing policies and adaptation plans that would be an integral of national plans and policies Further they added that demonstration activities and training should be given top priority in the awareness programmes. The local people should also actively participate in the preparedness programmes and awareness programmes and should use the knowledge gained through these activities in practical life.

Acknowledgement

The study team members take this opportunity of showing gratefulness towards WWF-Nepal and YONSED for providing the opportunity to carry out “Community Based Disaster Risk Appraisal”. The study team members would like to express their sincere gratitude to all the staffs of WWF-Nepal and YONSED for their constant inspiration, guidance, and encouragement for the completion of this study. The special thank goes to Mr. **Ashok Baniya** of WWF-Nepal, Rasuwa for his guidance and valuable suggestions.

The study team members would like to thank the local people of study areas, all the participants of the Questionnaire surveys, focus group discussions, and key informant’s interviewers. We are thankful to Mr. Santosh Ghale, Mr. Suman Lama, Santosh and Sunil of LUCCAS, Dhunche Rasuwa and Mr. Gyan Lama of Bhorle, Rasuwa for their whole hearted cooperation during the field studies.

Genuine Thanks are extended to secretary of Bhorle and Ramche VDCs, as well as Nepal Red Cross Society, Manekor Society and Lantang National Park, Dhunche, Rasuwa for the precious information.

We are indebted to Mr. Rajesh Pyakurel, officer of district forest and soil conservation office, Dhunche Rasuwa for his valuable suggestions.

We would also like to express our special thanks to Mr. Kamal Thapa, for helping in preparing GIS map and the information needed to complete this report.

The Study Team Members

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1 BACKGROUND

1.1 Introduction

During the past few decades the world has been experiencing significant increase in global temperature resulting into climate change. Climate change is happening and it is affecting every corner of the world. However, there is more general information available on Climate Change and its impact. Local communities have observed increased unpredicted floods, landslides, heavy soil erosion, river cutting and drought as major hazard aggravated by climate change (Agrawal et. al. 2003). Due to these changes water availability and agriculture productivity have also been severely affected.

Nepal is more likely to be affected by adverse impacts of climate change with its poor resources. Climate change has led to significant change in precipitation, temperature and other climatic parameters which significantly affects the biophysical and socioeconomic conditions. Temperature observations in Nepal from 1977-1994 show a general warming trend (Shreshtha et al.1999). Mean temperature of Nepal is increasing by 0.4 °C per year (Bhaidya, 2007). Rainfall too has become erratic and the overall temperature is increasing despite negative trends. Therefore, adaptation to climate change must be a priority for the country.

Climate change is impacting at the grass root levels; therefore localized information on climate change and its impact are important (Practical Action, 2007). It is more so in the case of Nepal where the vast variation in geography creates number of microclimates. It is essential for implementing the effective measures to help the poor communities to cope and adapt to the impacts of climate change.

People have always adapted to the variations in climate by adapting to changes based on their resources and knowledge accumulated through their past experiences. But this alone hasn't proved fruitful in adapting to climate vulnerabilities so a local development plan involving climate smart responses are required. For this the community people, the scientists and the policy makers should work together to consider the implications of climate change. There is an immediate need to address current and future climate vulnerabilities into development plans

Development efforts that have focused on poverty reduction sustainable livelihoods have proved an important means to reduce vulnerability but it has tended to neglect the impact of climate extremes. The magnitude and intensity of the present climate variability and the climate risks are having negative impacts of development so addressing them is an urgent task.

The ability of communities to adapt to climate change is determined by their level of development, their access to resources and their scientific and technical capacity. Adaptation can adopt a variety of forms from better education, training and awareness of climate change and more technical measures, such as drought-resistant seeds and alternatives for agriculture.

The communities and individuals will have to continue to adapt to climate change and failing to do so will stop the future development. Thus a community based adaptation survey will help to encompass the adaptation practices prevalent in the area that would be useful to integrate it into local development plan.

For this YONSED and WWF team conducted a community based survey at Rasuwa district in two selected VDCs: Ramche and Bhorle. The study was carried out to have a knowhow of community based adaptation at these two specific VDC most severely affected by the impacts of climate change.

The survey would help in finding out community based adaptations most prevalent in the area so that they can be mainstreamed in local development plans. This would help in coping of the community to the vulnerabilities and risks exacerbated by natural disaster in the area.

1.2 Scenario of Climate Change

According to the rainfall distribution of the country, the southern sides of the main Himalayan Range have a greater rainfall than the Terai or the Northern sides across the Himalayas. The variation is from 1000mm to 3500mm a year. The highest annual rain falls at Pokhara (3540 mm, 7 years average). This area therefore may be named as *Chairapunje* of Nepal. Compared to this rain, Jomsom which is about 32 miles as a crow flies, shows an annual rainfall of 275mm and is one of the lowest in the country. The whole of this area behind the main gets less than 1000mm rain which has made this area almost cold desert (Baidya, 1968).

The climate in Nepal varies from the tropical to arctic within the 200 km span from the tropical to the south to north. Much of Nepal falls within the monsoon region, with regional climate variations largely being a function of elevation. National mean temperatures hover around 15° C, and increase from south to north with the exception of mountain valleys. Average rainfall is 1,500 mm, with rainfall increasing from east to west. The northwest corner has the least rainfall, situated as it is in the rain shadow of the Himalayas. Rainfall also varies with the altitude; area over 3,000 m experiences a lot of drizzle, while heavy downpours are common below 2000m (Baidya, 1968). Although annual rainfall is abundant, its distribution is of great concern: flooding is frequent in the monsoon season during the summer, while droughts are common in certain regions in other parts of the year.

1.2.1 Crops, Soils and Irrigation

The main food crops of Nepal which depend upon the South west monsoon rains are rice and maize. Rice is grown most extensively in the warmer Terai belt although one may find its cultivation extending as high as 2300 meters (7600 ft) in the Jumla area. The area cultivated under paddy rice is the largest in the country. The unpredictable monsoon rain especially for the warm Terai belt has made irrigation planning a very important part of the stable agricultural economy in the country.

To save the farmers from variations like these in the cultivations of most important crops like paddy and to fulfill the water requirements of cash crops like sugarcane or potatoes, jute, other vegetables and wheat and well worked out irrigation projection projects and farms in which due attention is also given in efficient use of water is essential.

Various climatic patterns in the country, as elsewhere in the world has developed variations that could lead to vegetation changes in this country according to attitude, climate as well as soil that has developed due to the joint action of climate and vegetation. In Nepal the tundra soils, pudzol soils, zonal and azonal soils having red, grey, yellow or black or brownish color are in the hills and alluvial type is prevalent in the Terai.

The hilly areas, where a greater percent of the people live, do have fertile lands especially along the valleys. Most of these valley soils and hill soils have good natural drainage system. These

soils in general are therefore low in calcium content. This has helped the growth of acid requiring plants like Rhododendron and the berries in the high altitude.

As in case of Nepal, land area under irrigation had increased from 23.7 percent in 1981/81 to 44.0 percent in 2001/02. In 1981/82, 19.8 thousand hectares (3.3%) in mountain, 119.2 thousand hectares (20%) in hill were irrigated land. Likewise in 1991/92, 41.8 thousand hectares (5%) in mountain, 245.5 thousand hectares (28%) in hill were irrigated land. In the same way in 2001/02, the irrigated land of mountain, hills were 62.1 thousand hectares (5%) and 304.9 thousand hectares (26%).

Sources of irrigation water can be groundwater extracted from springs or wells, surface water withdrawn from rivers, lakes or reservoirs or non-conventional sources like treated wastewater, desalinated water or drainage water. A special form of irrigation using surface water is called spate irrigation or floodwater harvesting. Spate irrigation areas are in particular located in semi-arid or arid mountainous region. While floodwater harvesting belongs to the accepted irrigation methods, rainwater harvesting is usually not considered as a form of irrigation. Rainwater harvesting is the collection of runoff water from roofs or unused land. Therefore this method is considered as a water conservation method.

Various types of irrigation techniques differ on how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire source uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little.

In surface irrigation systems water moves over the land by simple gravity flow in order to infiltrate the soil. Surface irrigation can be subdivided into furrow, boarder strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land.

Drip irrigation also known as trickle irrigation, functions as its name suggests. Water is delivered at or near the root zone of plants, drop by drop. This method can be most water efficient method of irrigation. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and also the means of delivery of fertilizer.

In sprinkler or overhead irrigation, water is piped to one or more natural locations within the field and distributed by overhead high-pressure sprinklers or guns mounted overhead on permanently installed risers referred to as a solid-set irrigation system. High pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive or impact mechanisms.

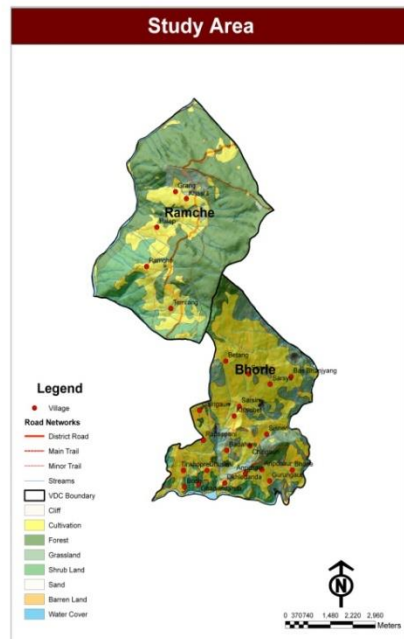
1.2.2 Vulnerability

Nepal, a landlocked country of around 27 million people, is vulnerable to several natural hazards due to its geographical and climatic variations requiring different coping strategies to minimize the negative effects. Landslides and floods are common water induced disasters threatening the livelihoods of the people. Apart from landslides and floods, Nepal faces high magnitudes and intensities of natural hazards like earthquake, fire, cyclonic winds and hailstorms, cloudburst, drought, famine, and epidemics.

Nepal has been ranked 142 of 177 countries in the United Nations Human Development Index, and has an annual per capita GDP of just US \$272.00 (UNDP, 2007). This poverty, coupled with the fact that 79% of the population and around 40% of the country's GDP, rely on agriculture for livelihoods, means that Nepal's vulnerability is high, and its capacity to respond to challenges of natural hazards is limited. The vulnerable groups, mainly poor people from the rural and urban areas, are in a dilemma of economic hardship, insufficient knowledge on disaster management, low literacy rates, inadequate physical infrastructure, poor forecasting facilities and unplanned settlements. This situation leads to a number of frequent problems related with the livelihoods of the vulnerable people.

Vulnerability is an indication of people's exposure to external risks, shocks and stresses and their ability to cope with, and recover from, the resulting impacts. Vulnerability may differ seasonally or at different times within people's lives. It also differs across groups within communities or individuals within a household, owing to their livelihood activities or social standing.

1.3 Study Area



Bhorle and Ramche VDCs are the major VDCs of Rasuwa, which lies at the central development region of Nepal. The geographical location is between 85°32"N & 85° 19" N longitude and 27° 56"E & 28° 06"E Latitude (Survey Department, 1992).

Ramche VDC is surrounded by Dhaibung, Laharepauwa, Dhunche, Haaku, Yarsa, Danda Gaon, and Bhorle VDCs of Rasuwa (District Profile). While the border of Bhorle VDC is adjoined with Dhaibung, Shramthali, Yarsa, Ramche VDCs of Rasuwa, and Nuwakot district to the south (District Profile, 2005).

Fig: 1 Map of Study Area

1.3.1. Socio-Economic and Biophysical Condition

1.3.1.1. Population

According to population census by CBS in 2001 the population of Bhorle and Ramche VDC are 5935 and 2153 with 1078 and 397 individual households respectively. The average family size are 5.5 and 5.42 which are near to national average, mountain and hill average of 5.44, 5.28 and 5.17 and the sex ratio found to be 101.7 in Bhorle and 108.7 in Ramche VDC (CBS 2001). Annual population growth rate is 2.0 percent in Bhorle and 2.2 percent in Ramche. 65.44 percent Tamang, 0.007 percent Newar, 1.22 percent Chhetri, 19.73 percent Brahman, 3.26 percent Kami, 0.004 percent Sunar, 0.001 percent Tharu and 0.09 percent Magar resides in this Bhorle VDC. In Ramche VDC, 96.47 percent Tamang, 0.008 percent Brahman, 0.005 percent Chettri, 0.006 percent Kami and 0.005 percent Tharu resides (Rasuwa District Profile, 2005).

1.3.1.2. Education

There are two primary and a secondary school in Bhorle VDC while Ramche has two primary and a lower secondary schools. The overall male literacy rate of Rasuwa district is 42.5% and of female is 24.5%. The literacy rate of Ramche VDC is 10.1 % while of Bhorle VDC is

35.3%. Of the total population, 14.3 % male and 5.4 % female of Ramche and 46.1 % male and 24.4% of Bhorle VDC are literate (CBS, 2001)(Table 1

VDCs	Formal Education									Informal Education		
	Primary			Secondary			Higher Education					
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Ramche	9.9	4.0	7.1	2.9	0.8	1.9	1.4	0.5	1.0	0.0	0.1	0.0
Bhorle	26.2	16.2	21.2	10.3	4.6	7.5	4.7	1.0	2.9	4.8	2.6	3.7

Source: CBS, 2001

Table 1: Educational information

1.3.1.3. Poverty Level

According to study conducted by CBS for Small Area Estimation of Poverty, Caloric Intake and Malnutrition, 43.1 percent of total population in Bhorle VDC and 50.3 percent of total population in Ramche VDC are under poverty line. It is much larger value than national average of 31 percent. Poverty Gap shows that 18.9 percent population in Bhorle and 16.1 percent population in Ramche are near to poverty line. Caloric Intake Prevalence is 43.1 percent in Bhorle and 50.3 percent in Ramche VDC. 40.1 percent population in Bhorle and 41.5 percent population in Ramche VDC are under weight (Rasuwa District Profile, 2005).

1.3.1.4. Economic Activities

66.36 percent of total populations (above 10 year) in Bhorle VDC and 42.34 percent of total population (above 10 year) in Ramche VDC are involved in income generating activities. Male are more active than female, 1820 males and 1794 females in Bhorle and 827 males and 702 females in Ramche are engaged in economic activities. Out of 102 households only 12 households are independent to agriculture. Ten houses are engaged in business and 14 houses depend on government services in Bhorle while five houses are engaged in business and seven houses depend on government services. (Rasuwa District Profile, 2005).

1.3.2. Environmental Status

1.3.2.1. Land use

Ramche and Bhorle VDCs have diverse geography revealing various land use pattern. The following table shows the land use pattern of both the VDCs Ramche and Bhorle:

SN	Land Category	Percentage
1	Cultivated	43.24
2	Forest	30.74
3	Grass	11.03
4	Shrub	13.05
5	Barren	0.03
6	Sand	0.9
7	Conservation area	1.01

Table 2: Land use pattern

1.3.2.2. Temperature

Annual Mean Temperature of study area is 9.5 °C. Temperature is high in monsoon season with 17.63°C maximum mean and 11.29°C minimum mean and low in winter season with 8.84°C maximum mean and -1.22°C minimum mean.

Temperature Distribution (°C)												
S.N.	Station	Mean Annual	Annual MAX	Annual MIN	Pre- Monsoon		Monsoon		Post- Monsoon		Winter	
					MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1.	Dhunche	15.47	20.48	10.47	21.67	10.69	24.04	16.00	21.11	7.33	15.09	3.84
2.	Langtang	3.52	7.07	-0.03	6.68	-1.17	11.22	6.58	7.79	0.76	2.59	-6.29
3.	Mean	9.50	13.77	5.22	14.17	4.76	17.63	11.29	14.45	4.04	8.84	-1.22
Temperature Trend (°C/year)												
S.N.	Station	Mean Annual	Mean MAX	Mean MIN	Pre- Monsoon		Monsoon		Post- Monsoon		Winter	

					MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	Dhunche	0.012	0.132	- 0.107	0.074	- 0.116	0.158	-0.04	0.188	-0.16	0.108	-0.215
2	Langtang	0.151	0.076	0.227	0.143	0.238	0.13	0.123	0.049	0.192	-0.019	0.356
3	Mean	0.0815	0.104	0.06	0.1085	0.061	0.144	0.0415	0.1185	0.016	0.0445	0.0705

Table 3: Temperature fluctuation**1.3.2.3. Precipitation**

The mean annual precipitation in Rasuwa district is 1159.05mm and high precipitation occurs in the month of June, July and August. Snowfall occurs in those areas which are located above 1900m altitude during winter season.

Rainfall (mm)						
S.N.	Station	Mean Annual	Pre-monsoon	Monsoon	Post-Monsoon	Winter
1	Dhunche	1948.424	280.7655	1118.507	407.631	141.5207
2	Langtang	617.0185	92.683	400.0495	96.62	27.666
3	Timure	911.7182	124.1636	541.7061	192.9848	52.86364
Mean		1159.054	165.8707	686.7542	232.412	74.01678

Table 4: Precipitation Pattern**1.3.2.4. Change in Water Runoff/Discharge**

Rainfall Trend mm/year						
S.N.	Station	Mean Annual	Pre-monsoon	Monsoon	Post-Monsoon	Winter
1	Dhunche	0.799	-5.461	16.32	-3.716	-6.342
2	Langtang	7.364	3.061	4.615	-0.026	-0.285
3	Timure	6.611	-0.461	5.031	1.993	0.048
Mean		4.924667	-0.95367	8.655333	-0.583	-2.193

The trend analysis of available discharge data of Trisuli River at Betrawati station has been carried out. Mean annual discharge of Trisuli River is 213.86 m³/sec and the annual trend of discharge is increasing by 2.667 m³/sec. Discharge in monsoon is increasing by 7.724 m³/sec

and decreasing in winter by $-0.144 \text{ m}^3/\text{sec}$. In monsoon season 57.96% of total discharge occurs and in winter least discharge occurs. That is 6.07% (DHM) .

Discharge of Trisuli River at Betrabeti					
	Average Annual	Pre-monsoon	Monsoon	Post-Monsoon	Winter
Discharge (m^3/s)	213.8615	72.86667	495.7822	234.8867	51.91056
Discharge Trend	2.667	0.244	7.724	2.846	-0.144

Table 5: Discharge pattern

1.4 Objectives

Risk assessment of local development plans with climatic lens ‘climate SMART’ responses.

1.5 Limitations

The research work is limited:

- The sample size of the study was restricted to 15% of the total HHs.
- The study was primarily based on the perception of community peoples.
- No advanced engineering tools were adopted for the assessment

2.0 METHDOLOGY

The study adopted the following process:

2.1 Data Collection

The data and the related information were collected through primary and secondary methods.

The primary data collection method was carried out through following methods:

2.1.1 Focal Group Discussion (FGDs)

Focal group discussions were conducted to collect relevant information for the climate change adaptation and disaster risk. FGDs were majorly focused on climate triggered disasters in the area along with the involvement of GOs, CBOs and institutions and ethnic communities for the authenticity of the collected data.

2.1.2 Individual Perception Measure

A pre-prepared questionnaire was attempted to collect the information and perception of key informant that would helped in preparing the report. The questionnaires were attempted among the selected sample size that represented the whole study area. Besides, formal and informal conversations were made with the concerned persons and experts to enrich data.

2.1.3 Secondary Data Collection

Data collection involved research of various published or unpublished materials related to disaster risks that were prevalent in Rasuwa District especially those prompted by changing climate.

2.2 Data Analysis

The collected data were entered into spreadsheet and necessary calculations were made from that database. After the completion of data organization and calculation, the analysis of the data was carried out. For land use map of study area description GIS software is used to explore the clear picture of Bhorle and Ramche VDC.

3. RESULTS AND FINDINGS

3.1. Agriculture and Spatial Analysis

Agriculture is always vulnerable to unfavorable weather events and climatic conditions. Despite technological advances such as improved crop, weather and climate are still key factors in agricultural productivity. Since climate varies over space, its effect on agriculture also varies spatially and its spatial pattern is likely to change as the climate changes. By mapping these altered distributions, it is possible to provide place-specific information for policy makers concerning altered levels of resource availability due to climate change. Ability to conduct such analyses has been improved with the development of computer-based GIS, which can be used to store, analyze, and depict spatial information.

The GIS component describes regional characteristics of land, climate, water, and agricultural suitability. In this approach, climate change is assumed to shift the regional land class and water characteristics, thus altering the production possibilities for a given region. A comprehensive GIS-based analysis was used in order to demonstrate the change in climate and its effect on agriculture practice.

For the interpolation, following meteorological stations which are around the study area were selected.

- | | | |
|------------------|----------------|-----------------|
| 1. Jomsom | 2. Larke Samdo | 3. Jagat |
| 4. Chekampar | 5. Nuwakot | 6. Pansayakhola |
| 5. Dhunche | 8. Langtang | 9. Timure |
| 10. Tarke Ghyang | 11. Jiri | |

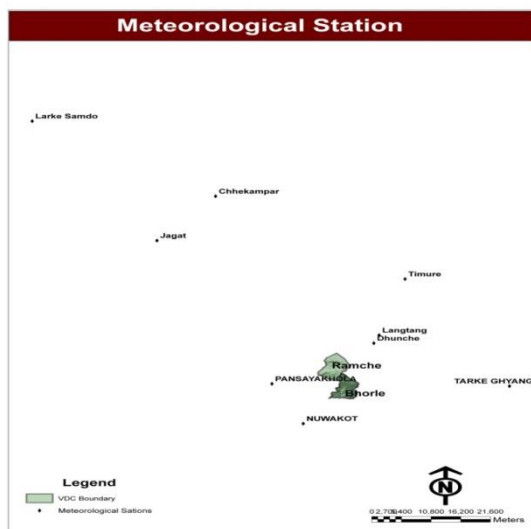


Figure 2: Meteorological station

3.2. Temperature Change

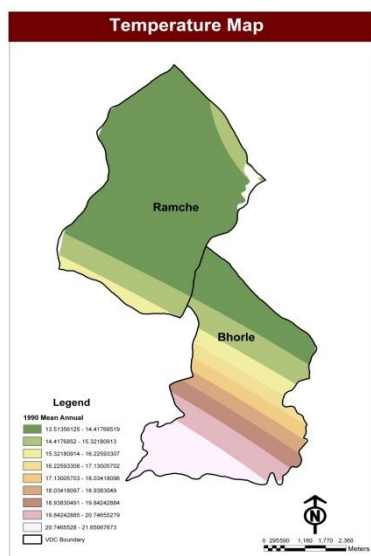


Figure 3a: Mean Annual Temperature (1990)

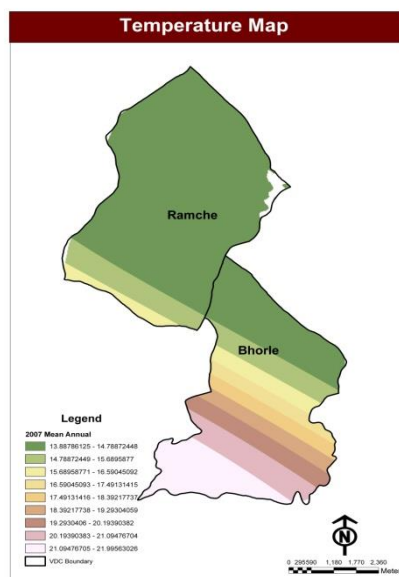


Figure 3b: Mean Annual Temperature (2007)

It has been observed that cold areas are decreasing day by day with an average of 1.08% of total area per year (Data Analysis). When we compare to mean annual temperature of 1990 and 2007, the area covered by less than 14°C is decreasing by 18.39%. Respectively maximum (area covered by less than 16°C) annual and minimum annual temperature (area covered by less than 12°C) is decreasing by 7.43% and 13.82%.

Hotter areas are increasing in Bhore and Ramche VDCs by 0.84% in total area of VDCs per year. Comparison between average temperature of 1990 and 2007 shows, the area covered by more than 13.5°C is increasing by 14.42% (Household survey 2009).

3.3. Precipitation

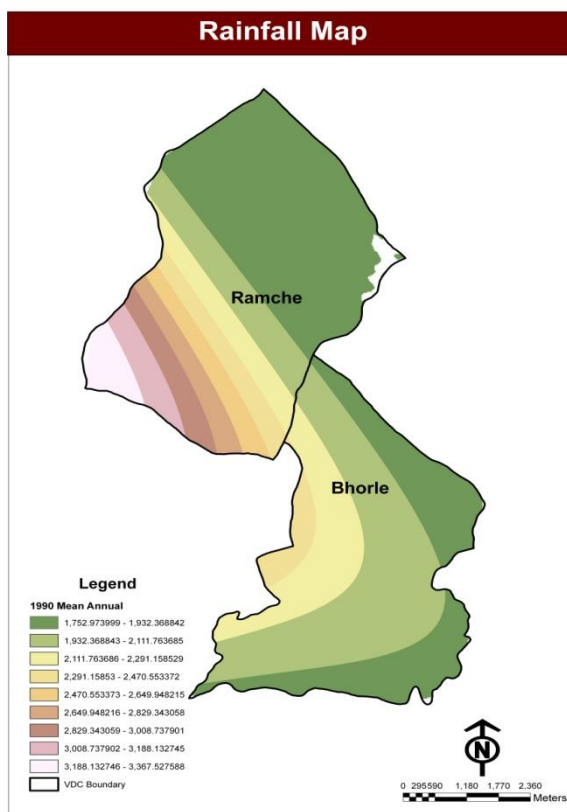


Figure 4a: Mean annual precipitation (1990)
(2007)

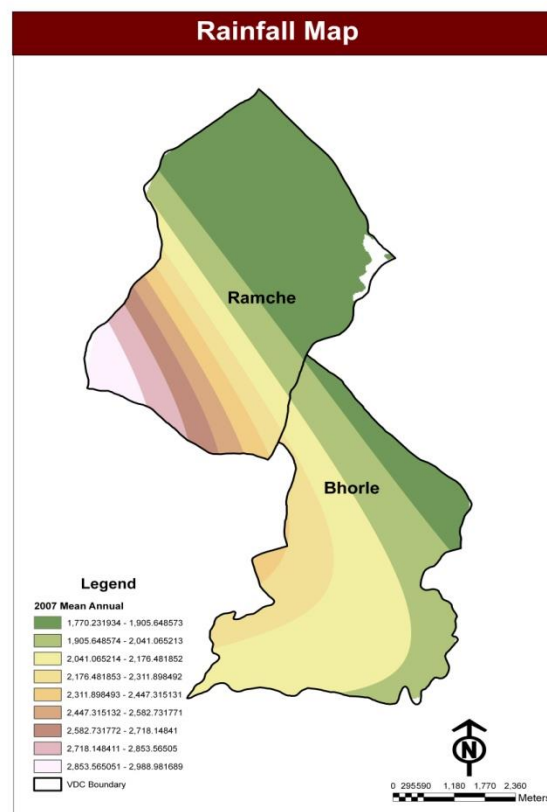


Figure 4b: Mean annual precipitation

Interpolated map shows that average rainfall is increasing in 2007 (971.47-1,067.21mm) Bhorle near Betrawati area in comparison with 1990 (815.20-950.57mm).the rainfall is high in monsoon season which is 541.41 to 610.71mm but it is less than other areas. Less rainfall occur on winter season that is 51.39-59.21mm in cultivated area.

In past there were only 3.08% area which gets high rainfall (more than 1000mm) but now there are 33.62% of total area gets high rainfall. It is clear that percentage of heavy rainfall (more than 1000mm) area is increasing.

3.4. Result of questionnaire survey

3.4.1 Community Perception on Climate Change

SN	Perception on Climate Change	Respondents	Percentage
1	Seasonal Variations	35	26.92
2	Untimely Rainfall and weather patterns	42	32.30
3	Enhanced by artificial causes especially pollution	12	9.23
4	Depletion of water resources	10	7.70
5	Don't Know	31	23.85
	Total	130	100

Table 6: Perception on Climate Change

Maximum no. of the respondents (32.3%) of both Ramche and Bhorle regarded climate change as untimely rainfall pattern and change in weather patterns. Very high percentage (76.85%) didn't have clear view about climate change. Some respondents even regarded climate change as that exacerbated by artificial causes while some even linked it to depletion of water resources.

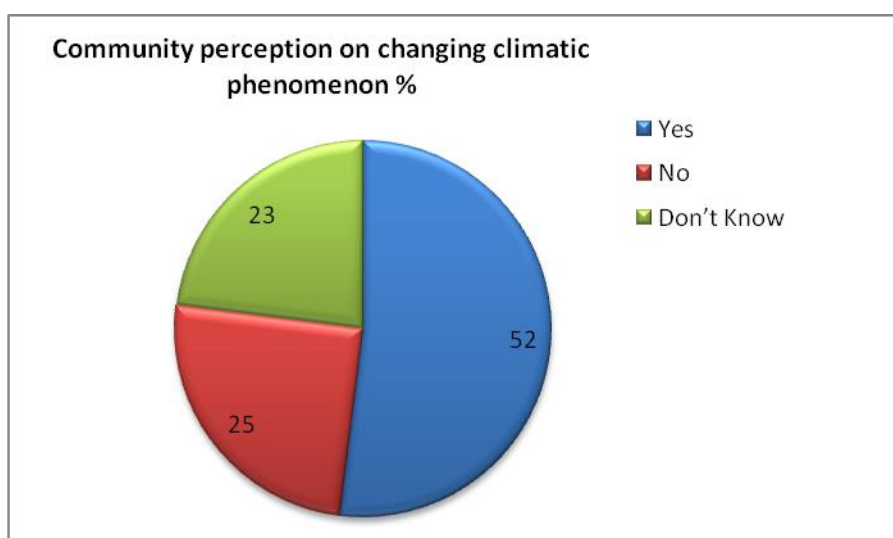


Fig 5: Perception on Changing Climatic Phenomena

In the survey regarding the community perception on changing climatic phenomenon, most of the respondents of both Ramche and Bhorle responded that climatic phenomenon is changing. However, some of the respondents don't have clear idea regarding changing climatic phenomenon.

3.4.2 Climate change and Disaster Risk

Most of the people of Bhorle believed that climate change is enhancing disaster risk. About 43% of people in Ramche and 59.5% in Bhorle believed that disaster risk is increasing due to climate change. However, 44% respondents in Ramche and 17.5% in Bhorle had no idea regarding climate change enhancing disasters.

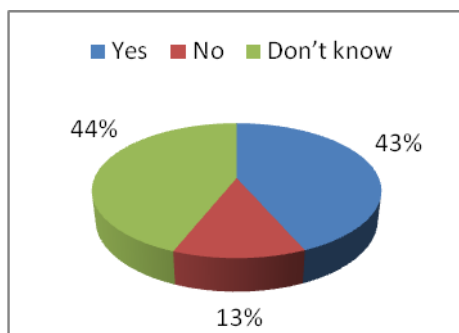


Figure: 5(a) Climate change and disaster risk (Ramche)

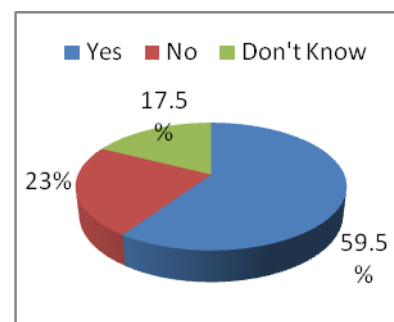


Figure: 5(b) Climate change and disaster risk (Bhorle)

3.4.3. Changes in Disaster Pattern

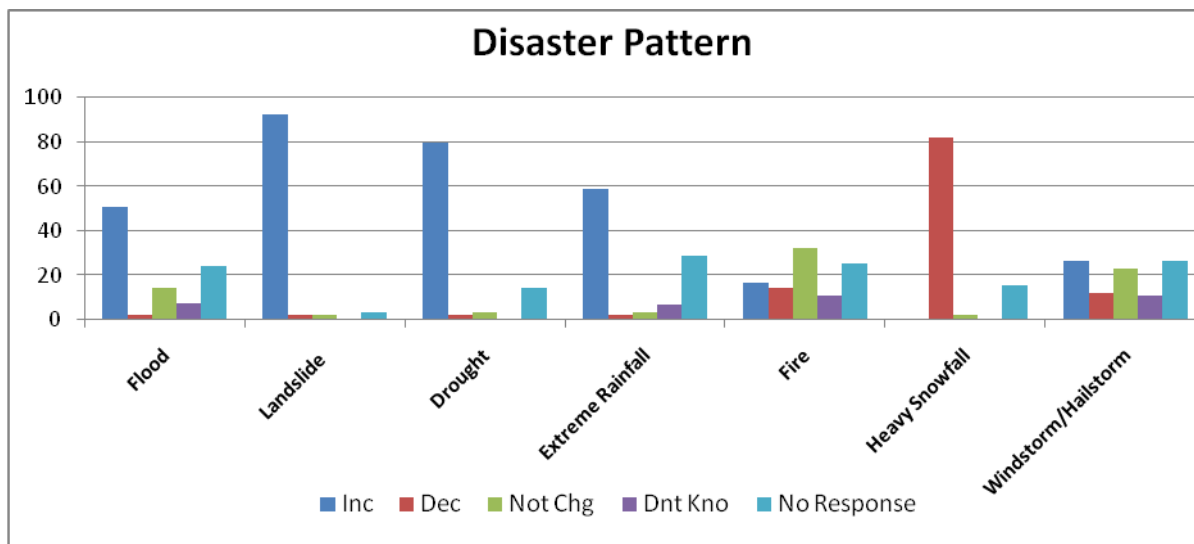


Figure 6a: Changes in disaster pattern (Bhorle)

Changes in disaster pattern enhanced by climate change showed that flood frequency has increased in both Ramche and Bhorle. Similarly, landslide and extreme rainfall has also increased in both the areas. The fires in the area has not changed as such. Similarly, the heavy snowfall has decreased in the area.

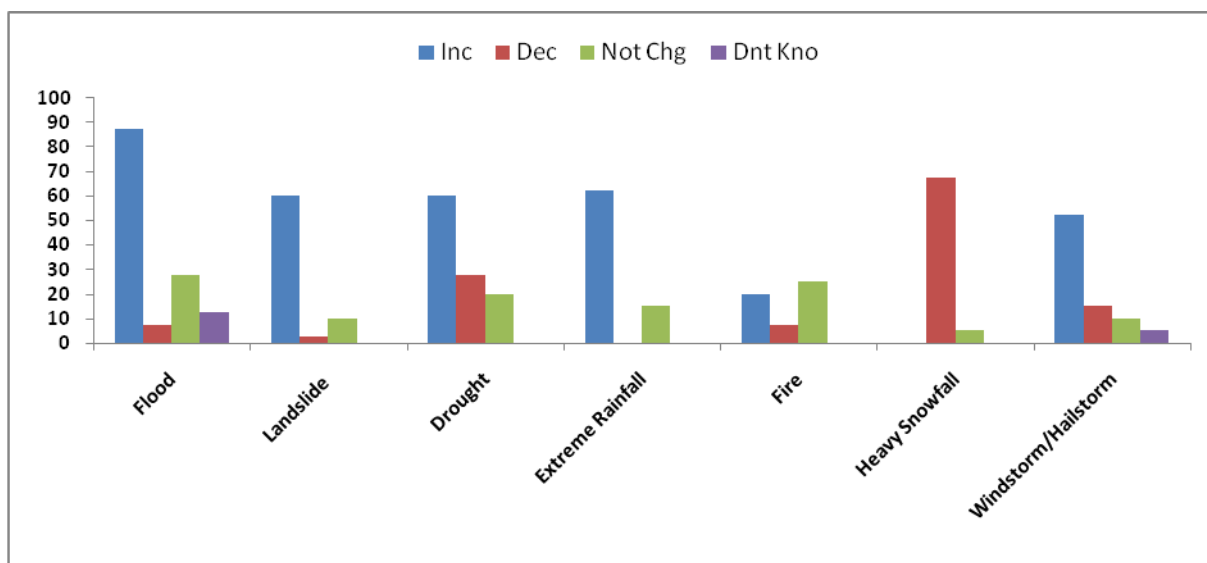


Figure 6b: Changes in disaster pattern (Ramche)

3.4.4. Temperature and Precipitation Pattern

77.82% and 84.33% of respondents of both Ramche and Bhorle respectively think that temperature is increasing. 20.99% of people in Ramche and 12.95% in Bhorle regards that temperature remains the same as before and 1.19% and 2.72% of respondent of Ramche and Bhorle respectively perceive that temperature is decreasing. People of the area think that the temperature is increasing and the hotter days are increasing in summer and colder days are decreasing in winter.

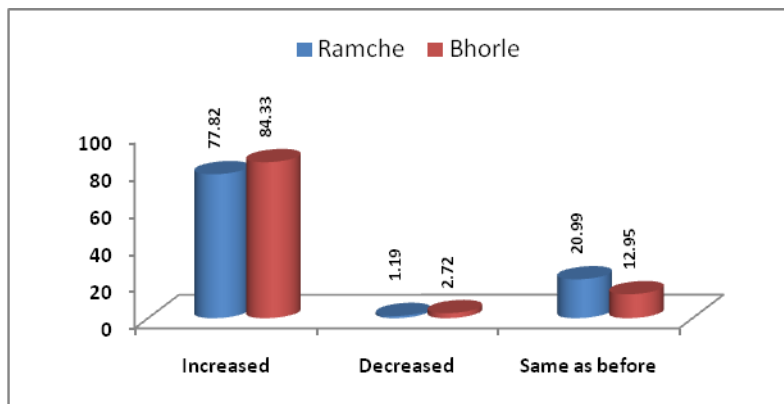


Figure 7: People's Perception on Change in Temperature

58.24% and 63.4% of people of Ramche and Bhorle respectively think that annual rainfall is decreasing, 12.5% respondent of Ramche and 14.6% of Bhorle think that rainfall is increasing, 12.1% and 14.02% of respondents of Ramche and Bhorle respectively, think that rainfall is same as before while 17.16% people of Ramche and 7.98% of Bhorle think that there is untimely rainfall in the study area. Rainfall in winter season is decreasing while in monsoon season it is increasing. Respondent who are directly related to agriculture has experienced that rainfall is in decreasing trend.

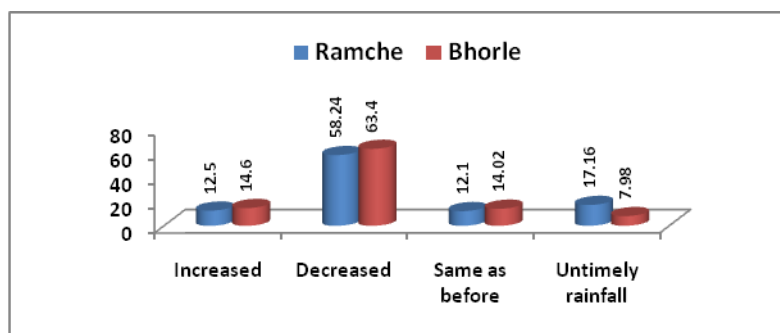


Figure 8: People's Perception on Change in Precipitation

3.4.5. Impact on Agriculture

People in both Ramche and Bhorle had noticed decrease in agricultural production due to changing climatic phenomenon. Most of the people (85.24% in Ramche and 76.54% in Bhorle) said that the agriculture production has decreased. About 3.32% in Ramche and 3.39% in Bhorle however thought that the agricultural production is increasing while 11.44% in Ramche and 20.07% in Bhorle said that there is no significant change in agricultural production. Irregular rainfall pattern, drought and hailstorms had decreased the agricultural production. Alternative cropping method like unseasonable vegetable cropping had helped to make up for the loss of crops.

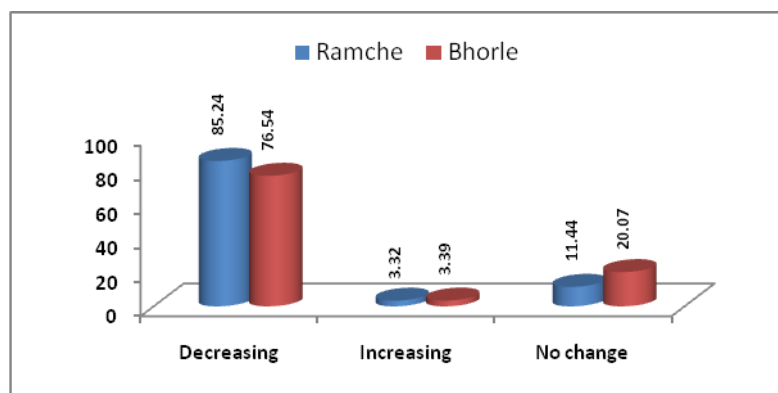


Figure 9: Perception on Changing Agricultural Production

3.4.6. Water Resources for drinking purpose

33.32% of respondents in Ramche and 52.56% in Bhorle were using tap water for drinking purpose, 43.44% in Ramche and 24.32% in Bhorle said that they use river water for drinking purpose and 23.24% in Ramche and 23.12% in Bhorle said that they were using spring water for drinking purpose.

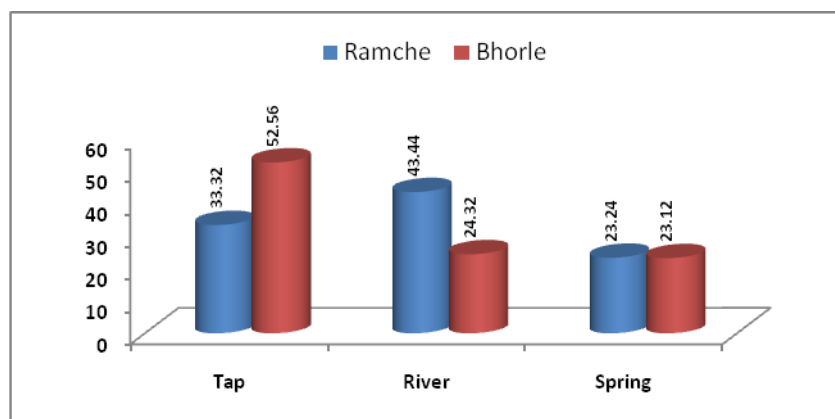


Figure 10: Use of Water Resources for Drinking

People from both Ramche and Bhorle said that there was high scarcity of drinking water especially during dry months. The decrease in sources of drinking water is probably caused by low rainfall, landslides and irregular rainfall patterns.

3.4.7. Adaptation for Water Scarcity

People are using piped water (10% in Ramche and 32.33% in Bhorle) for drinking water to reduce time taken to collect water. 27.5% in Ramche and 8.89% in Bhorle had constructed

ditches to collect water for drinking purpose. Similarly, 12.21% in Ramche and 32.12% in Bhorle had constructed storage tanks to collect rainfall water that could be used later for drinking purpose. Very high no. of respondents i.e. 43.23% in Ramche and 28.89% in Bhorle had not undertaken any adaptation measures to reduce the scarcity of drinking water.

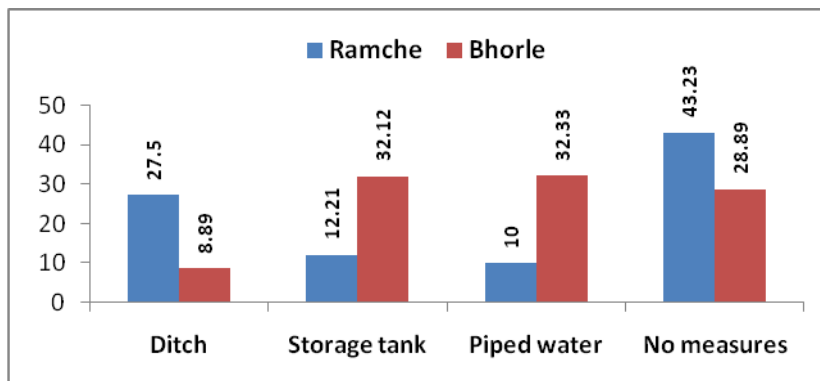


Figure 11: Adaptation for Water Scarcity

Regarding irrigation, 51.11% in Ramche and 39.33% in Bhorle had not undertaken any adaptation measures to reduce the crop loss prevailed by scarcity of water. However, 45.56% of people in Ramche and 54.78% in Bhorle used waste water to irrigate their crops in some parts of their lands. Very few, 3.33% in Ramche and 5.89% in Bhorle had constructed irrigation canals however not so effective.

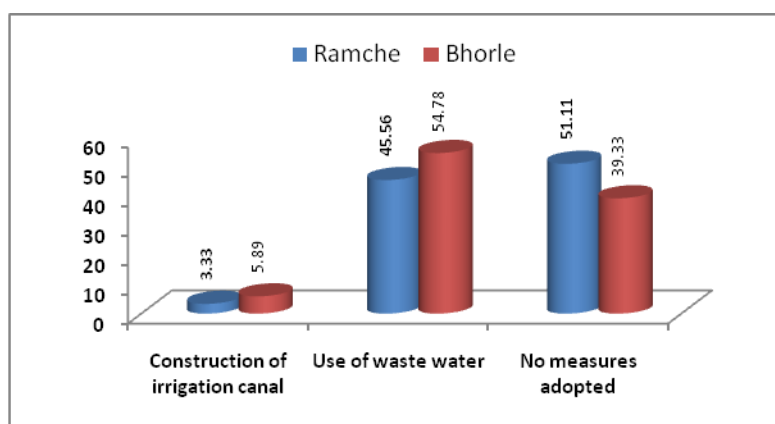


Figure 12: Adaptation For Irrigation

3.4.8. People's Perception on Forest Resource

Most of the respondents (45.24% in Ramche and 54.32% in Bhorle) regarded that forest condition had improved. The probable reasons for this may be due to formation community

forest user groups that had helped in proper management of forest in Bhore. In Ramche, the Buffer Zone Program had prevented the forests of the area from getting degraded. However, 24.34% in Ramche and 33.34% in Bhore regarded that the forest resources are being degraded due to pressure from population growth and greater demand of fuel wood and other resources. 30.42% in Ramche and 12.34% in Bhore however thought that the forest conditions are same as before. 45.24% in Ramche and 54.32% in Bhore however thought that the forest conditions are same as before.

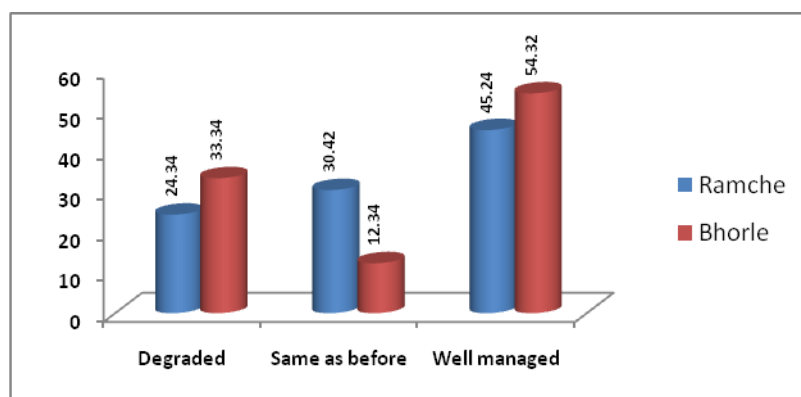


Figure 13: People's Perception on Forest Resources

3.4.9. People's Perception on Future Extreme Events

During the field visit people told that if the climate change trend remain same then it will affect livelihood of people severely. 52.5% respondent of Ramche and 66.67% respondent of Bhore said that there will be reduced agriculture production, 30% of Ramche and 33.33% of Bhore said that there will be scarcity of drinking water, 12.5% of Ramche and 7.78% of Bhore said that there will be migration of people, 67.5% of Ramche and 47.78% of Bhore said that huge landslide will occur, 22.5% of Ramche and 18.89% of Bhore said that forest will be degraded, and 27.5% respondent of Ramche and 35.56% respondent of Bhore stated that economic status of the people will be decreased.

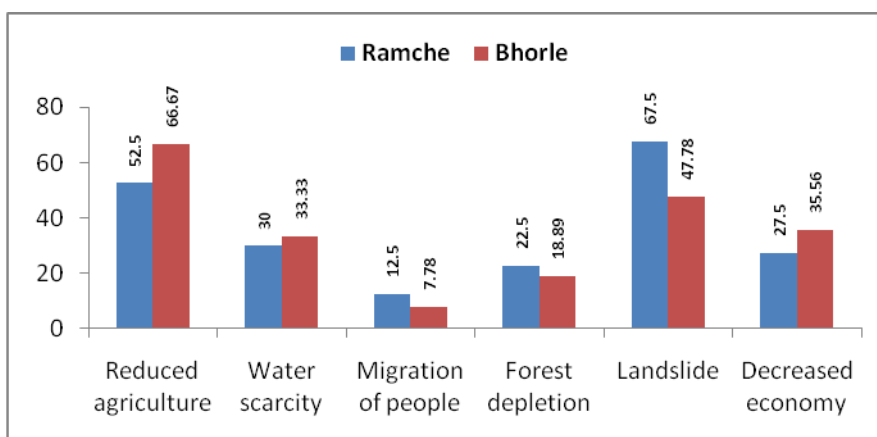


Figure 14: People's Perception on Future Extreme Event

3.5. Results from FGD and KII

Focus Group Discussion(FGD) and Key Informants Survey (KII) was conducted to gather information on perception of people on climate change, role of climate change in enhancing disaster risk and adaptations undertaken to combat the impacts of climate change.

3.5.1. Ramche

A FGD was conducted in Ramche. The results obtained from FGD and KII are presented below:

3.5.1.1. Perception on Climate Change

Most of the people had no idea regarding climate change although they have experienced the impacts of climate change

3.5.1.2. Role of Climate Change in Enhancing Disaster Risk

Drought prevails in winter continuously and decreased production. There is no crop cycling. Production has reduced a lot. . Climate change and its effect have been at high level at these VDCs. The major indications can be the irregular rainfall patterns, lack of snow in the high mountains, increasing droughts, hailstorms affecting the crops and its production. These problems were not so significant before 2-3 years.

3.5.1.3 Impacts of Climate Change

New species of insects in crops has been observed since last year especially in cabbage and radish. Rhododendron which flowers in Chaitra and Baishak only, now blossom in Mangshir and dies which is about 3 months earlier. The growth of vegetables along with potato, wheat at altitude of 2500 m is the significant impact. Low snowfall in Padol Himal.

3.5.1.4. Adaptations

The landslide and mitigation is uncontrollable by the community initiative and depending on the government for the provision of gabion wires. In the year 2062/2063, rehabilitation programs were also brought forward which involved various package programs for awareness and education involving school feeding programs. Various genuine programs like livelihood

support, income generating activities were also brought forward. So trainings, capacity building programs, infrastructure development and regular plans for rehabilitation can be a big solution.

The alternatives and adaptation:

- 1) Agricultural replacements
- 2) Vegetable farming at Ramche
- 3) Awareness
- 4) Continuity of adaptive programs

Changes have also been observed at livestock rearing. People had left agricultural activities and are taking interest in business. They are also planting fodders at large. But in some communities at Ramche there is nothing on climate change adaptation practice and they don't have much idea regarding climate change and its impacts. They had no idea regarding temperature and precipitation changes and snowfall pattern too.

3.5.1.5 Suggestions/recommendations

- Decreasing the boundary of the national park that would end the restriction for the people to use natural products from the forest and helps in preventing the degradation of their economic status.
- Trainings, capacity building programs, infrastructure development and regular plans for rehabilitation can be a big solution.
- Making people responsible citizens

3.5.2. Bhorle

A FGD was conducted in Bhorle. The results obtained from FGD and KII are :

3.5.2.1 Perception on Climate Change

Climate is changing. Snowfall is lacking, rainfall is low. In Sarmathali Dada, 3 years ago huge snowfall was observed. Temperature has increased a lot. One plant called Buljhar has already been lost. Since last 5-7 years snowfall has decreased. In Satdhare Himal (4500-4800m), less snowfall has been observed since last 4 years. Papaya growth has been observed. No guava plant now in the area. Since last 6-7 years, mosquitoes have been increasing.

3.5.2.2 Role of Climate Change in Enhancing Disaster Risk

Climate change has maximized disaster risk.

4.0. CONCLUSION AND RECOMMENDATIONS

Conclusion

Most of the peoples in the study area (Ramche and Bhorle VDCs) don't have clear view about climate change. It clearly reveals that the habitants of the study area still lack awareness on climate change. Climatic phenomenon of study sites are changing and climate change is enhancing disaster risk in these areas. Changes in weather pattern enhanced by climate change showed that landslide and flood frequency have increased in both Ramche and Bhorle VDCs. People of the study area think that the temperature is increasing and the hotter days are increasing in summer and colder days are decreasing in winter.

Respondents who are directly related to agriculture have experienced decreasing rainfall trend. Although few traditional alternative cropping methods have been practiced to make up for the loss of crop production but those methods are not well enough to cope with the prevalent food scarcity of the study areas. People of both Ramche and Bhorle have high scarcity of drinking water especially during dry months. However, the Buffer Zone Program has been helpful in conserving the forest area from getting degraded but still numbers of peoples assumes that the excessive use of forest resources and climate change may imparts a negative impact on forest cover at a noticeable extent. Hence appropriate awareness programme on alternative energy use should be carried out. Besides the community skill on climate change adaptation and natural resource management should be enriched with trainings and awareness programs. Moreover, an adaptation plan should be brought forward that would help in sharing experiences, obstacles and bring about positive initiatives within the communities and concerned stakeholders.

Recommendations

- A community based network pertaining to climate change should be formed to enhance awareness of the local communities on climate change and its impact. Besides, possible local adaptation measures should be brought forward.
- Frequent, workshops, interaction and talk programmes pertaining to climate change should be carried out at local and district level to exchange the ideas and information. It fills the gap among the concerned organizations stakeholders and the community peoples.
- Indigenous methods and knowledge should be promoted while developing and implementing coping and adaptation strategies as to climate change locally.
- As climate change has multiple effects in locality, the most affected sector (agriculture) should be taken as the entry point for developing and promoting an integrated programme.
- The climate change adaptation approach should include a diverse range of conservation and development activities, including strategies for disaster risk reduction.
- The VDCs of study area should give top priority and importance to adaptation to climate change while planning for development programmes.
- The community peoples should be enriched with the trainings of improving the livelihood along with the climate change adaptation and sustainable use of natural resources.
- An integrated climate change adaptation plan should be developed in detail to maintain better coordination among local stakeholders and concerned governmental and nongovernmental organizations to work in a holistic way at community level.

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ANNEXES

Annex A: Questionnaire

QUESTIONNAIRES

Disaster Risk Reduction Appraisal and Risk Assessment

Respondent No:

Date:

HOUSEHOLD SURVEY

1. Introductory Background

District :

VDC/Ward :

Respondent Name :

Caste/Ethnic Group :

Sex :

Age :

Education :

Occupation :

2. Family Structure

SN	Relation to Respondent	Sex	Age(yrs)	Marital Status	Education	Occupation		
						I	II	III
1								
2								
3								
4								

5								
7								
8								
9								
10								

3. How much is your annual income in terms of money

.....

4. How much is your annual expenditure in terms of money?

.....

Climate Change Related Issues

5. What do you mean by climate change in your opinion?

6. Is Climate Changing?

a. Yes		b. No	
c. Don't Know			

7. Is Climate Change enhancing disaster risk in your area?

a. Yes		b. No	
c. Don't Know			

8. Can you give me the details of loss from disasters in last five years?

9. What are the Changes you feel on the following in these years?

Disaster	Increased	Decreased	Not Changed	Don't know	Remarks
Flood					
Landslide					
Drought					
Extreme rainfall					
Fire					
Heavy snowfall					

Windstorm/Hailstorm					
Others					

10. Is there any change in temperature and precipitation pattern?

Changes	Temperature	Precipitation
Increased		
Decreased		
Same as before		

11. Impact of climate change on agriculture

a. Increasing		b. Decreasing	
c. No change			

12. What are the sources of drinking water?

a. Tap		b. River	
c. Spring		d. Others	

13. What are the alternative measures adopted for water scarcity

a. Ditch		b. Storage tank	
c. Piped water		d. No measures	

14. Adaptation measures for irrigation

a. Construction of irrigation canal		b. Use of waste water	
c. No measures			

15. Peoples' perception on status of forest resource?

a. Degraded		b. Well managed	
c. Don't know			

16. What are the possible future extreme events?

a. Reduced agriculture		b. Water scarcity	
c. Migration of people		d. Forest depletion	
e. Landslide		f. Decreased economy	

17. Are there any organization working in disaster and climate change in this area?

a. Yes		b. No	
--------	--	-------	--

If yes, specify names:

SN	Name	Address	Activities
1			
2			
3			

18. What are your suggestions or recommendations regarding the issues of adaptation to climate change in this area?

i. Local People.....

ii. Government.....

iii. NGOs/INGOs/ CBOs.....

Annex B: Checklist for FGD

1. Perception about disaster
2. Acquaintance with the forecasting of the media and precautions undertaken
3. Natural disaster most prevalent in the area
4. Details of loss in last 5 years
5. Frequency and magnitude of the most prevalent disaster
6. Population/household/livestock losses due to these disasters
7. Most vulnerable areas in the site
8. What are the effects you felt after disaster?
9. What measures did you take to mitigate effects of the disasters?
10. Any community awareness initiatives by local governments/NGOs/CBOs?

11. Availability of particular skills to mitigate the risk in disaster prone communities (indigenous knowledge).
12. Preventive and adaptive measures undertaken to reduce the losses
13. Perception about climate change
14. Role of climate change in enhancing the disaster risk
15. Mitigation measures adopted to combat climate change
16. Any organization working for disaster and climate change in the area?

Annex C: Participants at FGD

FGD conducted during the study (Bhorle)

SN	Name	Address
1	Bir Bahadur Tamang	Bhorle-05
2	Bahadur Singh Tamang	Bhorel-05
3	Bir Man Thing	Bhorle-05
4	Bishnu Bahadur Tamang	Bhorel-05
5	Sanu Mukhi Thing	Bhorel-05
6	Sundar Moktan	Bhorle-05
7	Pabitra Moktan	Bhorel-05
8	Radhika Thing	Bhorle-05
9	Toksaani Tamang	Bhorel-05
10	Suman D.M.	Dhunche-05
11	Sangita Tamang	Bhorle-05
12	Kamala Tamang	Bhorle-05
13	Nisma Lama	Bhorel-05
14	Jagat Bahadur Tamang	Bhorle-05
15	Sanukancha Moktan	Bhorel-05
16	Buddhi Bahadur Moktan	Bhorel-05
17	Raju Thing	Bhorle-05

18	Sarita Moktan	Bhorel-05
19	Shyam Kumar Gurung	Bhorle-05
20	Gyan Bahadur Thing	Bhorel-05
21	Phanindra Neupane	Bajeshwori H.S. School
22	Bal Bahadur Gurung	Padampur-02, Chitwan
23	Ragbendra Jha	Bajeshwori H.S. School
24	Bhuwan Gurung	Shree Paye Sisnery
25	Aaita Ram Munkata	Bajeshwori H.S. School
26	Ramesh Gurung	
27	Dharma Bahadur Tamang	Bajeshwori H.S. School
28	Gar Kumar Gurung	Bajeshwori H.S. School
29	Ra Bahadur Gurung	Bajeshwori H.S. School
30	H.N. Chaudhary	Bajeshwori H.S. School
31	Suntali Gurung	Bajeshwori H.S. School
32	Kalpana Gurung	Bajeshwori H.S. School

FGD conducted during the study (Ramche)

SN	Name	Address
1	Chiring Ghale	Ramche-03
2	Furpa Gyalbo Ghale	Ramche-03
3	Kancha Tamang	Ramche-03
4	Nima Sangbo Tamang	Ramche-04
5	Furpa Tamang	Ramche-03
6	Kippa Sangmo Tamang	Ramche-03
7	Mangali Tamang	Ramche-03
8	Tashi Nurpu Tamang	Ramche-03
9	Nima Lakpa Tamang	Ramche-03
10	Pratap Tamang	Ramche-03
11	Risubandi Tamang	Ramche-04
12	Nurpu Tamang	Ramche-03
13	Kamsya Tamang	Ramche-03

14	Dawa Lamo Tamang	Ramche-03
15	Sancha Tamang	Ramche-02
16	Sasang De Tamang	Ramche-07
17	Bikram Thing	Ramche-08
18	Pasang Buti Tamang	Ramche-03
19	Chirki Tamang	Ramche-03
20	Temba Nurpu Tamang	Ramche-03
21	Marku Lama	Ramche-03
22	Lama Nurpu Tamang	Ramche-03
23	Min Buri Tamang	Ramche-03
24	Putali Tamang	Ramche-07
25	Dil Bahadur Tamang	Ramche-07
26	Tarsya Tamang	Ramche-03
27	Kamsya Tamang	Ramche-03
28	Resham Tamang	Ramche-03
29	Butti Yalmo Tamang	Ramche-03
30	Mendo Tamang	Ramche-03
31	Dolma Tamang	Ramche-03
32	Subba Tamang	Ramche-09
33	Dolma Tamang	Ramche-03
34	Ursyang Tamang	Ramche-03
35	Briyalmo Syangma	Ramche-03

Annex D: Photographs



1. Interaction during the study



2. Landslide at Ramche



3. Scenic beauty offered by rhododendron and snow piled Himalaya



4. Agricultural pattern



5. Landslide