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Climate Change Induced Water Conflict in the Himalayas: A Case Study from Mustang, Nepal

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ABSTRACT The water remains at the centre of livelihood from the beginning of human civilization. Civilization enriched mostly on the fertile plains and river valleys. With times, people began migrating to highland slopes where there was easy access to water to use. Two villages in Mustang region of Nepal were considered for research to drill the causes of conflicts on water sources right and water shares. People's perception, traditional practices and field evidences from those two villages were collected and analyzed. There were no any conflicts over water rights between two villages over long period in the past (until 200 to 300 years before). When the natural hydrological process derailed, people felt effects in decreasing in agro products and pasture due to scarce waters. Worsening livelihoods reflected to conflicts over water in the area. Communities were not only demanding greater portion of water share but also were claiming exclusive right over sources. The inherent cause of conflict were climate change which appeared through dyeing springs and changing nature of hydrological cycles.

Key words: *Global warming, Water management, Mustang, Water conflict, Water share*

3 INTRODUCTION

The climate change has been impacting directly and indirectly on mountain hydrology. Mountain people's livelihood which is based on agriculture depends on water and wise use of available water (Manandhar, *et al.*, 2010). Most farmers have been perceiving climate and responding accordingly. Upland farmers of Villages like Muktinath, Kunja, Phalyak and Dharajong of lower Mustang have experienced changes in climate affecting changes in intensity and timing of rainfall and snow fall, as well as unusual rise in both summer and winter temperatures. Bases on their own indigenousknowledge and experiences, they have beenadapting at an individual level on both agricultural and non-agricultural part of lives. But agriculture based livelihood in this region has been facing a greater risk and so appropriate long-term adaptation strategies are to be developed.

Population growth has been increasing anthropogenic activities which has been altering the natural environment. Water source yield has been synchronizing with the changes to climate especially, in erratic precipitation (IPCC, 2007). Hence, changes in climate have been resulting in decrease in yield of springs and rivers

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inmountains (ICIMOD, 2009; Regmi *et al.*, 2008; IHP Nepal 2011). When an individaul finds hardship to sustain from the agro based means of livelihood, mobility/migration comes an option at rural community (Subedi, 1998). But when a community as a whole finds water resource scarce, in some cases, people adopt crooked and forceful means to own sources nearby. Lomangthan people at upper Mustang had applied similar means to own water resource (Basnet 2007). Climate change is considered as an unforseen cause for dissapearing water sources in Mustang region of Nepal. In such acontext, this research is focused on water conflict underpinned by climate change.

2 MATERIAL AND METHODS

3 THE STUDY AREA

A depth research was carried out in two locations of Kagbeni Village Development Committee of Mustang area which falls on rain shadow zone of Nepal. Selected settlements are called Dhakarjong and Phalyak (Figure 1). These are two adjoining settlements. These villages lie at an altitude of 3200 meter altitude. Population density of research area is only 4 whereas the density at the national level is 180 (CBS, 2012). Population in Mustang district and at research village has a decreasing trend since 1981 (Figure 2). One of the reason favoring migration is that the region is highly dry with arid climate and desert type landscape. (NTNC, 2008).

3 METHODOLOGY

Data collection was carried out at two selected settlements. Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) techniques were followed while collecting data in the field. PRA puts a high premium on the active participation of the population and on the collection of quality information (Freudenberger, 2011). This method gives priority on team works in close collaboration with community members, involving them in all aspects of the collection and interpretation of information. People's perception aduring interviews is considered as an interpretation of local communities as a part of RRA report. Subjective interpretation also includes ethnomethodological approach (http:/en.wikipedi.org/wiki/ Ethnomethodology) for getting people's perception, knowledge, experiences, practices on self managed irrigation practices. People's perception and observation on climate changes were collected through questionnaire survey, focus group discussion, and key informant interviews. Primarily aged locals were contacted and interviewed. Other informants were randomly selected for the questionnaire survey. One focus group discussion was conducted in each village.

The research was focused at two locations as mentioned below on heading "The study area". Those two locations share a river source, have water scarcity induced by climate variability and conflict on water shares. The other settlements in Mustang region do also have water scarccity and disputs over water sources (Basnet, 2007). Lo-Mangthan, the capital city of Mustang, had a fight with a village called Tinghar that ended with the death of a villager. His death was negootiated with exchange of water sources (Basnet, 2007). Extensive investigations were carried out by previous researchers. But they have not looked into the causes on climate change perspective. Due to limited resources, only two settlemnts were chosen to drill out the cause of water conflict related to climate change.

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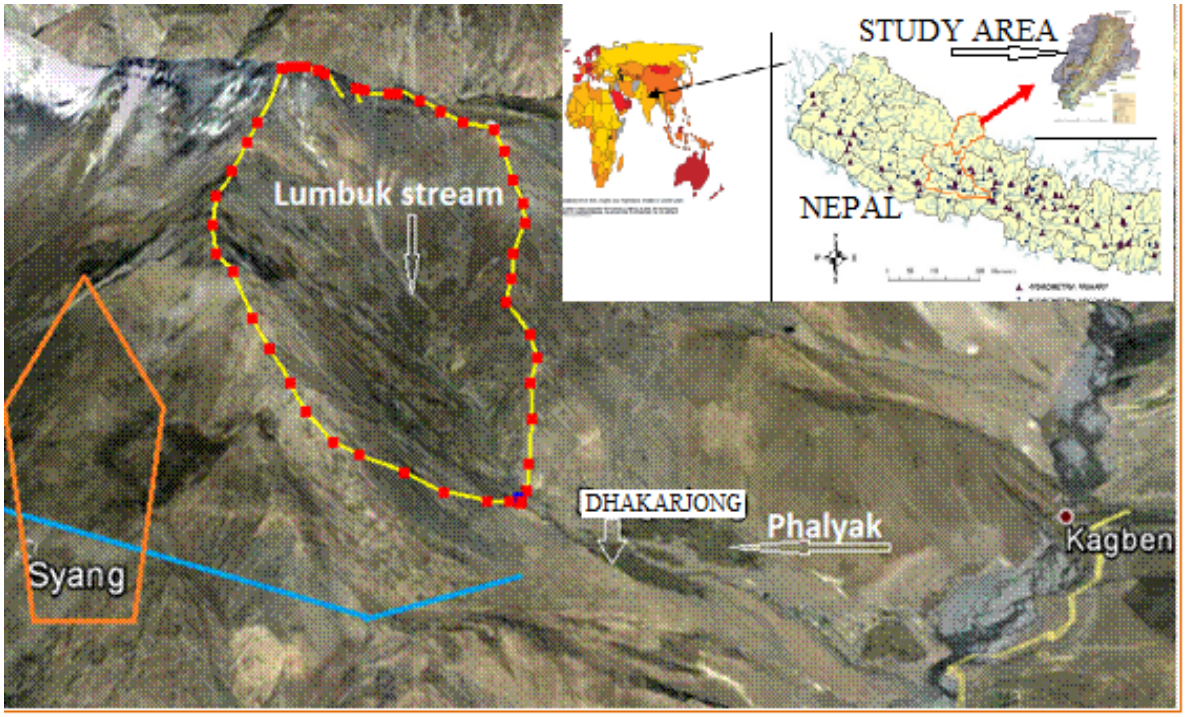

Figure 1 Location of Dhakarjong and Phalyak and Lumbuk River

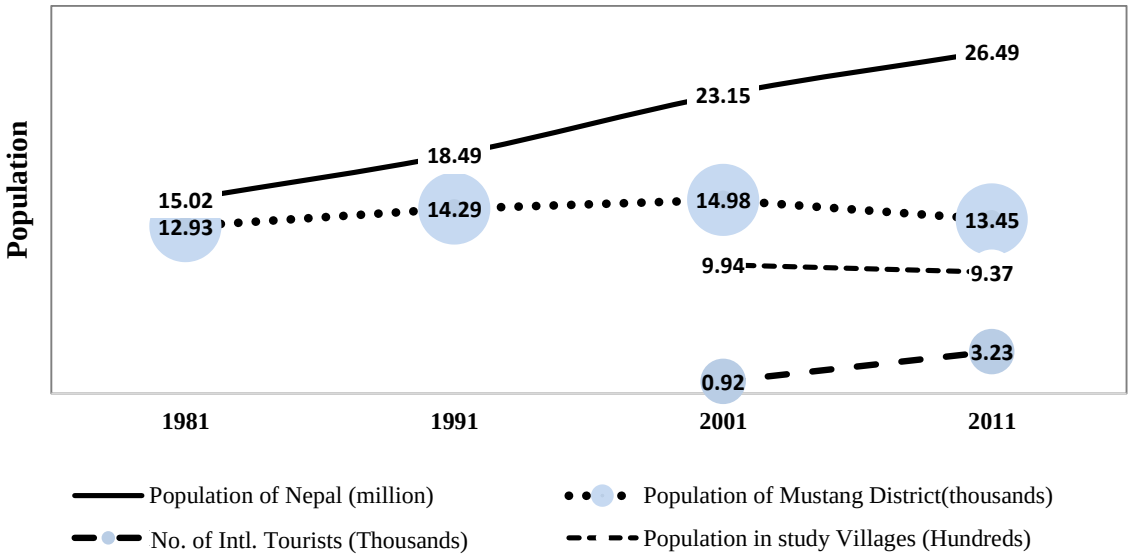

Figure 2 Population and tourists trend in Mustang and population trend of Nepal

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The area received 61%, 21%, 7% and 10% precipitation during Monsoon (June to September), Post-monsoon (October – November), winter (December to February) and Pre-monsoon (March to May) seasons respectively (DHM, 2008, 1999). Three field trips were carried out intensively for data collection from 2012 to 2013. These two villages have distinct characteristics like irrigation water scarce and conflicts on water sharing.

Now a days, the only source of water left for Dhakarjing and Phlyak is water from Lumbruk. This river originates from the hill (Figure 1). The length of river upto the intake is about 5 kilometers. The watershed area is 15 square kilometers. The river water is used for both drinking and irrigation.

3 RESULTS AN D DISCUSSION

modity in Mustang since centuries. Culture of the area isheavily influenced by Tibetan civilization. People were facing scarcity of food production due to limited useable land and limited water availability. This chapter describes climate change over the region, water conflicts and tradition on water right.

3.1 Climate Change

The IPCC AR4 has indicated that the warming in South Asia would be at least 2-4 degree Celsius by the end of the century. Earlier study based on annual maximum temperature records of Nepal between 1977 and 1994 hinted an average warming by 0.06 degree Celsius per year (Shrestha *et al.,* 1999). Later study indicated that the annual rate of temperature rise is 0.04 degree Celsius per year;and Nepal may experience warming on average by 3.5 to4 degree Celsius in the projected scenarios at the end of 21th century (MOPE /UNEP, 2004; Karmacharya *et al.,* 2007). All models have indicated that global warming is relatively faster in recent decades and is more severe in the Himalayan region. One study has indicated the mean temperature over the upper Kali Gandaki basin has a rising trend by about 0.02 degree celsius per year (Practical action, 2009; Baidya *et al*., 2008). Based on trend analysis on available data series at a meteorological station lying at an altitude of 2566 meter above mean sea level and close to the study area have indicated that there is 0.032 and 0.016 degree celsius rise in mean maximum and minimum temperature per year respectively. Inconsistency is more on precipitation trend because of widertemporal and spatial variation (Practical action, 2009; Baidya *et al*., 2008). The climate change and its effect in the area is subjectively verifiedby the local communities' oral history. Local people are aware and have experiencingthe effectofclimate change. The climate change impacts, according to local perception (IHP Nepal, 2011), are listed as below.

- Drastic decline in snowfall quantity and duration
- Temporal variability in rainfall and snowfall has occurred.
- Declining yield (spring sources are drying out) of the water sources has been visualized.
- Recession on river flows has been visualized.
- Increasing windy days and strong winds with silt have been affecting crops.
- Increasing floods, river sediments and changing river beds are observed.
- Some settlements (Samsung) at an altitude of about 4000 meter are at the junction of being refugees due to climate changes.
- Less pasture production due to less snow and rain during winter

Trend analysis carried out on observed temperature data (DHM, 2008, IHP Nepal, 2011) indicated the rising trend in maximum temperature (Figure 3) which also justifed the local perception on temperature rise.

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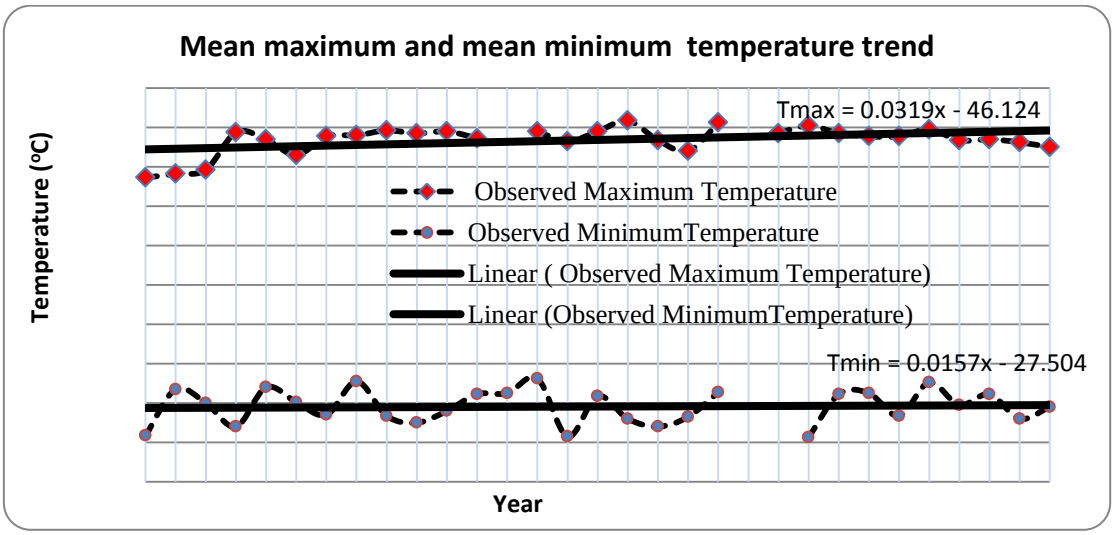

Figure 3 Temperature Trend At Thakmarpha In Upper Kali Gandaki Basin, Nepal

3.2 Climate Change and Water Conflict

During interactions with local people, it is found that there was no conflict over water rights between two villages over long period in the past, till 200 to 300 years ago (Bhusal and Chapagai, 2011). Now a days, there are conflicting versions over the right of Lumbuk River which is only one source available for the area. Phalyak people said that the water from Lumbuk was totally used by Phalyak along with first settlement and so they have full right over Lumbuk water. Contradicting to the version of Phalyak, communities of Dhakarjong said that they were using water of Lumbuk river even before Phalyak area got settled and agriculture started. Which location owns over Lumbuk river is still unsolved.

As per historical fact that is conveyed by older generations, it is said that people used Lumbuk water since its first settlement at ancient location (old Dhakarjong) which was first built on the top of a hill at Phalyak (Figure 4). When they shifted to the present location (Dhakarjong), they had constructed a canal from Shyang river. Water from Shyang was used for irrigation as well as household uses. This irrigation canal does not exist anymore but the traces of canal alighment from Shyang to Dhakarjong was noticed during field survey.

Dhakarjong people has been claiming that they were entitled to get riparian right because they were using Lumbuk source long before Phalyak agriculture practice statred farming Upper part land of Phalyak still belongs to the people of Dhakarjong. There was terrace cultivated and irrigated by a canal from Lumbuk But this part of the land is now barren due to lack of water in the river (Figure 4). Field survey data confirmed that 25 % of the land is left barren due to lack of water and labour force.

Mr. Pema Sitar, aged 88 year's old was one of a key informant. His version is given below. "I remember that my grandfather and mother were living in Phalyak village. I am now 88 year old. One can guess since when people were living in this location. The water sources were located at up the hill (Figure 5). The location and shape of the ancient lake is still visible at the hill. Now a days, even in the rainy period old sources of water i.e springs do not appear. Now a daya, Phalyak is totally dependent on water available at Lumbuk river. Lumbuk river is ours, Phalyak's property and, a water right over Lumbuk belongs to Phalyak. According to him Lumbuk river water was used since the beginning of earliest settlements at Phalyak. So they are claiming prior appropriative right to Lumbuk.

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Geographical locationofShyang river allows inter-basin water transfer by gravity canal (Figure 1). There was a canal constructed. But, no reliable information is available onforhow many years, the canal was operational. But due to huge costlabor forces required annually for maintenance and operation of the canal from Shyang (Figure 1), Dhakarjong people would have abandoned the canal and in repalcement, they began claiming water from Lumbuk river. At present, they have constructed a canal which is short and is oflow cost for maintenances.

Both villages have been claiming over Lumbuk river. After a long dispute, they negotiated and ended the quarrel by agreeing to share water. Water from Lumbruk river is diverted to both villages (Dhakarjong and Phalyak) from respective canals in turm. Total available water of the river is divided into five portions According to this system, Phalyak diverts river water for three days and Dhakarjong gets water for two days. But Dhakarjong people have been always insisting for equal share instead of 2-day and 3-day divisions. Dakarjong put claim of 50 % share to the chief district officer of Mustang in 2011. But Phalyak people denied but instead they agreed to support to bring water again from Shyang river.

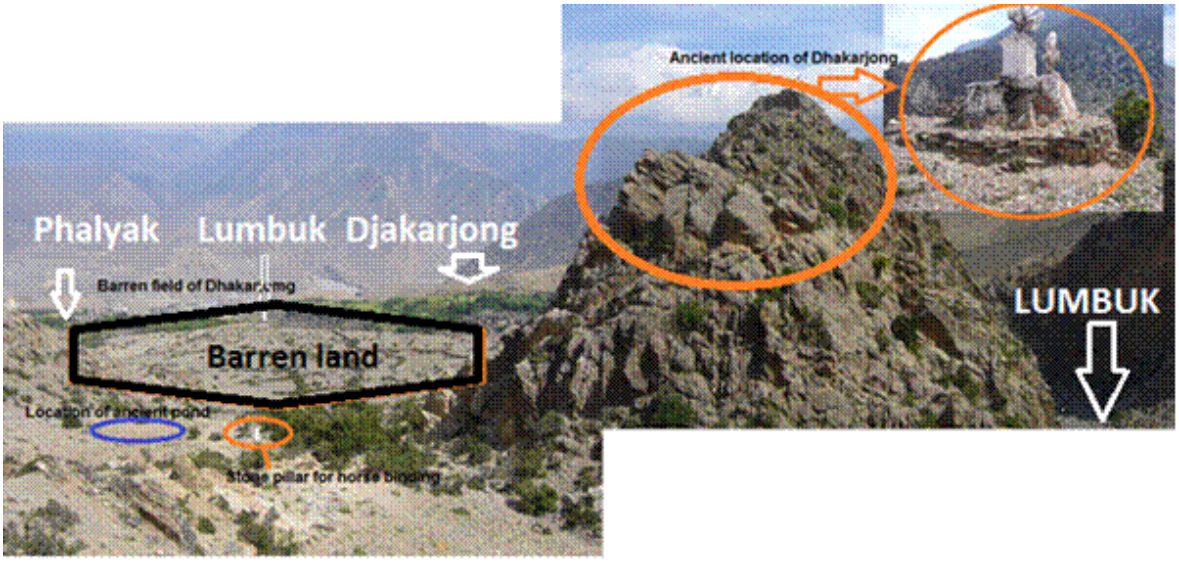

Figure 4 Location of ancient sttlement (Old Dhakarjong), Dhakarjong and Phalyak area

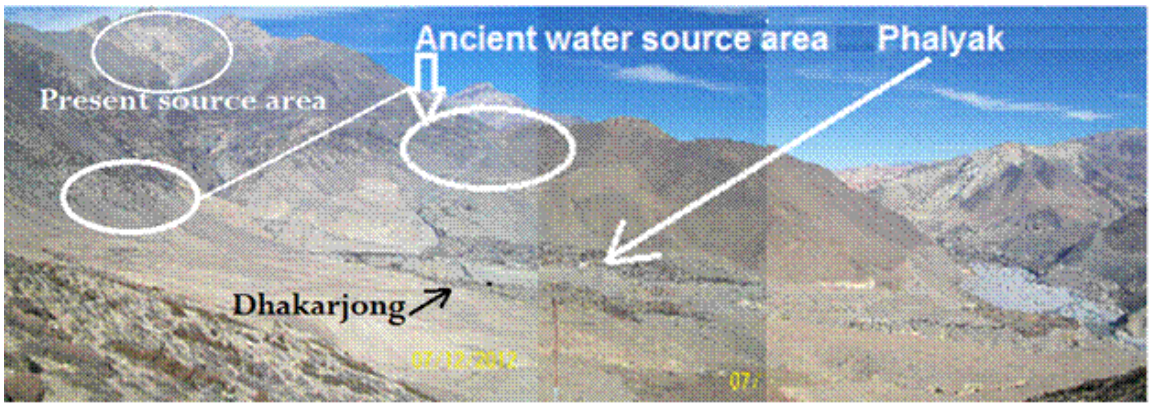

Figure 5 Location of study area and water sources

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The conclusion of versions reflected during field survey and interview with aged people is that the climate around a century before was more favorable for farming than of today. Underground water which is the source of springs would have been recharging frequently making sources perennial. But with prolonged dry spell spring sources dried out. Snow accumulation in the area had been working as solid water storage. In earlier days, melting process was delayed which had been providing continuous input through infiltration making water source perennial. From the field visit and local interview, it is clear that all sources of Phalyak and Dhakarjong are dried up now. The main reason is climate change. Anthropogenic effects like bushes clearance, over grazing and losses of pasture land would have accelerated and had added causes of drying sources in the study areas. The pressent bare land (Figure 3) around both locations clearly indicated clearan. Unless there is frequent precipitation as snow in the winter, drizzly type of rainfall in the Monsoon and longer period of snow accumulation in the area up in the hill slope, spring sources cannot discharge water constantly.

There used to be frequent snow fall in this region.. Snow accumulation in the ground and field used to be thick. Melting process used to lastfor days and even forweeks in several snow fall events. Delayed melting increases infiltration and keeps soil wet for longer period. Such phenomena makes soil wet and provides soil moisture for crops. Wet soil needs less amount of irrigation water. Till such natural process remained unaltered, people of Dhakarjong did not realize to bring water from rivers. Trend analysis on observed precipitaion (DHM, 2008, IHP Nepal, 2011) of the area has been showing an increase ttrend of precipitation as rainfall which coincides with oral history. There are not any snowfall measuring networks in the area. . However the oral history confirms the decreasing trend in snowfall days and amount. When such natural favor derailed, people felt effects in decreasing in agro products and pasture. Due to lack of water, an appreciable area is left barren in both settlements (Figure 3). Worsening livelihoods reflected the conflicts over water in the area.

Increasein anthropogenic activities along with population growth has been altering the natural environment in the Himalaya (Climate Himalaya 2012). The chances of infiltratiionhas been decreased due to eratic rainfall and decreasing snowfall. This had resulted in decrease in water yield of sources. Alteration in precipitation has been still complicating to the hydrological regimes.

Lack of financial resources and lack of village labor force are also linked towater disputes in addition to climate change. After the construction of canal from Shyang River to Dhakarjong, people would have had thought that canal provides sufficient water and needs negligible labor forces and financial resources to maintain. Soil type and structure of the canal alignment is so porous and fragile that water gets lost by seepage and canal getsdamage from ridge failures and slides. Dhakarjong people definitely would have found unexpected seepage loss and large resources for frequent maintenance. Cessus report of 2012 pointed out that at least one member of their household is absent or is living out of country. Lack of labor force and resources would have been compelling Dhakarjong people to abandon the canal from neighboring basin and get water from Lumbuk river. It is concluded that Dhakarjong would have used Lumbuk water unquestioned and undisturbed till Phalyak was not totally dependent on Lumbuk water as of today.

3.3 Tradition on Water Right

Over the years, Tibetan missionaries continued penetrating Mustang region,thereby influencing various sects of Buddhism (Hamilton, 1819). Accordingly, inhabitants in both locations are said to have heavily influenced by Tibetan civilization. People's indigenous faith is overlapped by Buddhism (NTNC, 2008) in current era. In Buddhist communities, tradition and

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religioninspires second son to go to Buddhist temple (Gumba) and become Buddhist priest (Lama/ monk). When he becames a LAMA, he is deprived of land and respective water rights. Parental land properties are shared among remaining brothers (NTNC 2008). The share of water right is automatically distributed in proportion of land they are entitled to get. If the second son comes back to the village and do not want to be a monk, he is entitled to receive the share of land, but in several cases, he does not get his full share of water right. Water became so precious that relationship between brothers and sisters in many cases become less important in comparison to shares of water. In the past, the selling of land automatically included the share of water right. Land right and water right were amalgamated together. Water is becoming so scarce that water right is made a separate entity and is separated from land right. Now a days, water right and land right are considered two separate identities in selling and buying practice. The cause of this is basically the climate change.

3.4 The underpinning process of climate to water conflict

The following Figure 6 summarizes the processes that are responsible for creating water conflicts between two communities of mustang district. The left side explains the process in the past till there was not any conflict on water right whereas right side represent the process that induced water conflicts.The centre cause is the eratic natural process in precipitaion and snow fall in the region.The rise in temperature has additional effect in fast snow melt that in earlier days. Variability in climatic process have negative impact in water balances, water yield whereas increased aridity has demanded more and more water for agroproducts which is directly related to peoples livelihoods. Combination of these effcts has resulted conflicts in water right and share.

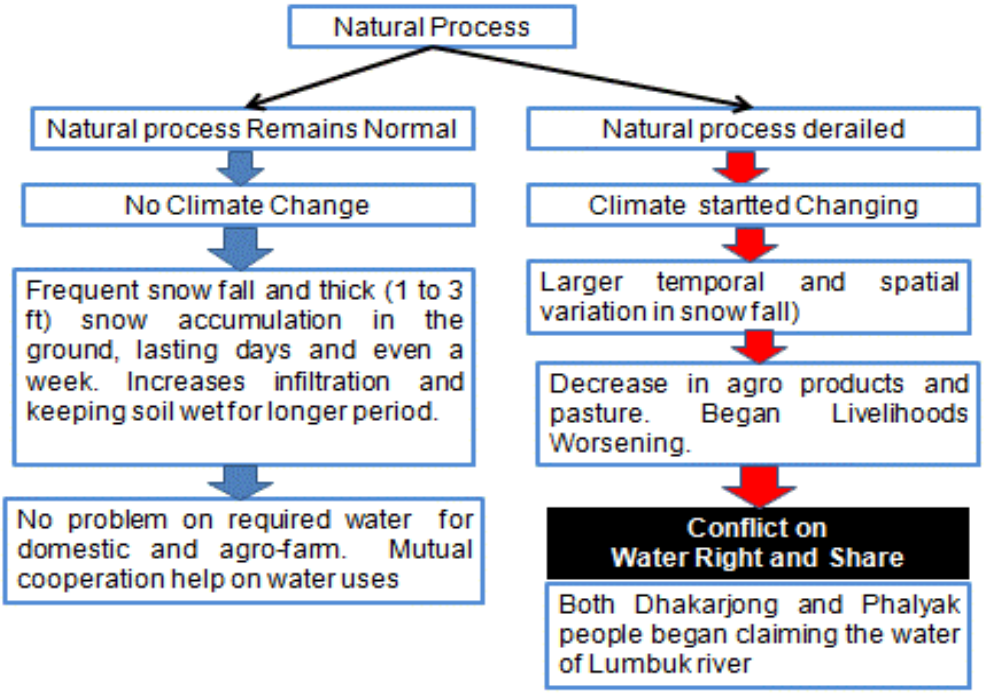

Figure 6 Underpinning process of climate to water conflict

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4 CONCLUSION

Climate change has resulted into conflicts among the households. The sitution is more serious in the case of high mountain area where there are limited cultivable lands when a community as a whole finds water resource scarce.

The agro-pastoral life was easy in the past because of smaller population and abundance of virgin natural resources. In ancient times, there were spring sources at higher locations; and people's used those sources for drinking water as well as for house yard farming. 5 % population of Mustang used river as the sources of drinking water (CBS 2012). In rainy season, those sources provided water for agriculture in wider areas. With time, situation is worsening,and yield from most of water sources especially spring sources, went on decreasing and dried out. One of the reasons is the temporal and spatial variability in precipitation induced by causes of climate changes. The amount of infiltrating water has been decreased..Snow accumulation in the ground and field isbecomimg thinner and thinner; and melting process is accelerated due to rises in temperature. Morphology of watershed especially vegetation cover and land use changed with time. All such changes are due to climate change which has underpinned the diminishing of water sources. Ignorance and lack of adaptive techniques also force people to go for new sources which in many cases aroused conflicts.

5 ACKNOWLEDGEMENT

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تغییر اقلیم ناشی از مناقشه آب در هیمالیا: مطالعه موردی موستانگ، نپال

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چکیده از آغاز تمدن بشری آب به عنوان محور معیشت بوده است. تمدن عمدتاً در دشت‌های حاصل‌خیز و دره رودخانه‌ها متمرکز شده است. پس از مدتی مردم به دامنه‌های کوهستانی با قابلیت دسترسی آسان به آب مهاجرت کردند. دو روستا در منطقه موستانگ نپال برای پژوهش در خصوص علل درگیری بر سر حق آبه و سهم آب در نظر گرفته شدند. داده‌های درک مردم، شیوه‌های سنتی و شواهد میدانی مرتبط با موضوع از این دو روستا جمع‌آوری و تحلیل شد. نتایج نشان داد در یک دوره طولانی در گذشته (۲۰۰ تا ۳۰۰ سال قبل) هیچ‌گونه درگیری بر سر حق‌آبه بین دو روستا وجود نداشت تا زمانی‌که فرآیند هیدرولوژیکی از حالت طبیعی خارج شد و مردم اثرات آن را در کاهش محصولات کشاورزی و مراتع با توجه به کمبود آب احساس کردند. به همین دلیل وخیم شدن معیشت منجر به ایجاد درگیری بر سر آب در منطقه شد. در ادامه جوامع نه تنها خواستار بخش بیش‌تری از سهم آب شدند بلکه مدعی حق انحصاری منابع آب نیز شدند. علت ذاتی درگیری بر سر آب، تغییر اقلیم بوده که از طریق خشک کردن چشمه‌ها و تغییر حالت طبیعی چرخه هیدرولوژیکی بروز نموده است.

کلمات کلیدی: جنگ آب، سهم آب، گرم‌شدن جهانی، مدیریت آب، منطقه Mustang نپال

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