CLIMATE CHANGE AND INDIGENOUS PEOPLE

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ABSTRACT

Climate change may be the biggest threats of the 21st century. Studies in the Himalayas a global biodiversity hotspot indicate that climatic changes have significantly impacted biodiversity and the people of the region and have shown that indigenous communities have already been adapting to the induced effects of climate change. Yet there is very little literature on the impacts or the response of the communities. At the same time there is a wealth of information in the form of local knowledge of the indigenous communities based on their observations, perceptions and experiences over the years. We conducted a series of household surveys in 2010 and 2011 in Lachen valley, North Sikkim to assess local perceptions and adaptation to climate change. The perceptions on the impacts of climate change were very detailed and provided numerous insights on local concerns. The data clearly suggested that the local people of the region have been experiencing changes in climatic conditions and natural surroundings including their grazing pastures and agriculture. The response of the people to adversities resulting from changing climatic conditions and their adaptation strategies particularly with the help of their local institution, the Dzumsa were documented. The study suggests that indigenous peoples have much to offer on the discourse on and actions countering climate change. To effectively tackle climate change the local perceptions, adaptations, responses and solutions must be kept in mind while being inclusive of the traditional institutions like the Dzumsa to effectively develop and implement adaptation and mitigation strategies.

Indigenous people have a wealth of knowledge based on their observations on the obvious links between climate change and biodiversity

Rheum nobile is among the many high altitude species threatened by climate change

Climate change is an all encompassing global problem that is likely to have catastrophic effects on natural and human systems. The IPCC Fourth Assessment Report (2007) has predicted extreme weather conditions and erratic rainfall patterns in various part of the world along with further cascading effects on biodiversity. Projected global mean temperature rise for the end of the century has been revised upwards from 1.8-4.0°C (IPCC 2007) to 2-7°C, with an increase of over 5°C seeming most likely given current emission trajectories (Sokolov et al. 2009).

Climate change has severe impacts on biodiversity resulting in altered phenology, (Penuelas and Filella 2001; Parmesan and Yohe 2003; Amano et al. 2010; Yu et al. 2010; Visser 2010) and shifts in distribution of species and biomes, (IPCC Techincal Paper V 2002; Bahn and Körner 2003; Parmesan 2005; Chen et al. 2011). Extinctions are also likely to increase considering that many species would not be able to adapt to the rapid rate of warming (Pounds et al. 1999; Thomas et al. 2005; Harley 2011).

Many studies have shown that climate change causes advances in spring phases of many plant species (Primack et al. 2004; Menzel et al. 2006; Primack and Miller-Rushing 2011). However, Yu et al. (2010) showed that strong warming in winter could slow the fulfilment of chilling requirements, which may delay spring phenology in certain plants.

Evidence for range shifts comes from many studies. Kullman (2004) showed that among the 29 vascular plants he sampled, most showed an increase in the altitudinal limits by about 165±20 m over the last 50 years. A recent meta-analysis by Chen et al. (2011) estimated that the distributions of species have recently shifted to higher elevations at a median rate of 11.0 meters per decade, and to higher latitudes at a median rate of 16.9 kilometers per decade. These rates are approximately two to three times faster than a previous meta analysis by Parmesan and Yohe (2003). Changes in species distributions resulting in altered interspecific interactions, community structure and diversity have lead to local and possible global extinctions (Harley 2011).

Agricultural systems and food production too would be severely impacted by climate change due to an increase in carbon di oxide (CO_2) levels in the atmosphere, higher temperatures and erratic rainfall coupled with modified weeds, pests and pathogen outbreaks (IPCC 2007; Schmidhuber and Tubiello 2007; Iglesias 2011; Müllera 2011). Changes in crop phenology have already started to provide evidence of the response to recent regional climatic changes. Low-latitude areas are at most risk of having decreased crop yields (IPCC 2007). Similarly "subsistence" or "smallholder" farmers are most vulnerable given that they are predominantly located in the tropics and various socio-economic and policy trends limit their adaptive capacity (Morton 2007).

Climate change has had wide ranging effects on human health leading to high mortality and morbidity (IPCC 2007; McMichael and Lindgren 2011). These include non-infectious health effects such as deaths due to heat waves and droughts resulting in increased malnutrition and infectious effects such as increase in vector borne diseases such as dengue fever, malaria as well as diarrhea (Patz et al. 2005). A study by the World health Organization (WHO) indicates that the climatic changes may already have been causing over 150,000 deaths since the mid-1970s (McMichael 2004).

In this chapter, we first outline the extent and magnitude of climate change in the Himalayas. We primarily focus on the perceptions of indigenous people, as our work is concentrated on local communities of the Lachen Valley of North Sikkim. We then discuss how pastoralists in Lachen Valley are coping with climatic change, particularly with the help of their local institution, the Dzumsa. We conclude with comments on the role of

institutions in helping local communities adapt to climate change.

CLIMATE CHANGE IN THE HIMALAYAS

Studies in the Himalayas, a global biodiversity hotspot (Myers et al. 2002), have shown that the mean temperatures in the Himalayan alpine zones has increased by 0.6 to 1.3 ° C between 1975 and 2006 (ICIMOD 2011; Dimri and Dash 2011). A majority of the studies on the Himalayas revolve around the extent of melting of the glaciers (Bagla 2009; Inman 2010) even though most of the glaciers have not been systematically monitored (Racoviteanu et al. 2008). The average retreat rate of glaciers in Mt. Everest is 5.5 -8.7 *m/a* since the 1960s (Jiawen et al. 2004). Nepal's glaciers are shrinking at a rate of 30 to 60 metres per decade (OECD 2005). On the Tibetan side of the range, 50% of the glaciers were retreating during the period 1950 to 1980 that rose to 90% in the 1980s and to 95% in the 1990s (WWF 2005). Studies by the Organisation for Economic Co-operation and Development (OECD) and others have shown that at least 20 such glacial lakes are at risk of bursting in Nepal, results of which would be disastrous. The Himalayas hold the largest mass of ice outside the Polar Regions and are the source of the 10 largest rivers in Asia, with their basins collectively providing water to more than 1.3 billion people (Xu et al. 2009). The receding glaciers will have numerous implications especially for future downstream water supplies (Yao et al. 2004; Barnett et al. 2005; Nogues-Bravo et al. 2007) and cascading effects on river-flows, groundwater, natural hazards, biodiversity, and livelihoods to name a few (Xu et al. 2009).

Although scientific data on climate change are limited for the Himalayas, there is wealth of information in the form of local knowledge. Indigenous people dependent on biodiversity and the provisioning services of nature in the form of grazing pastures, medicinal, aromatic or edible plants, water sources for irrigation to name a few are often the first to perceive changes in the environment . It would therefore be appropriate to refer to them as metaphoric "miners' canaries" with respect to the effects of climate change.

A second reason why local perceptions are important is that most climate change data and projections are on regional or national scales and are often difficult to apply to the local scale (Bridges and McClatchey 2009). Indigenous peoples have been experiencing local changes in their climatic conditions for millennia. They have an intimate familiarity with the natural rhythms and processes of their ecosystem (Vogt et al. 2002). Turner (2009) suggests that traditional ecological knowledge can be utilized as baseline long-term datasets developed over centuries of trial-and-error. Berkes (2002) demonstrates examples from the Arctic showing that it is possible for scientists and local people to work together and profit from various knowledge systems. Nicolas et al. (2002) used participatory research methods to explore local and traditional knowledge of the Inuvialuit people in the Arctic whose observations provided evidence of local change for multiyear ice distribution, first-year ice thickness, and ice breakup dates. Overall perception studies have indicated the significance of complementing scientific data with indigenous knowledge to improve climate change mitigation and adaptation strategies (Berkes 2002; Nicolas et al. 2002; Speranza et al. 2009).

In the Himalayas, there is concordance between scientifically recorded changes and local observations (Byg and Salick 2009; Chaudhary and Bawa 2011; Chaudhary et al. 2011). In Eastern Tibet, Byg and Salick (2009) recorded observations of climate change experienced by the villagers, variations in perceptions, impacts of the perceived changes and their interpretation of these perceived changes. Interestingly Byg and Salick (2009) point out that variations in perceptions were largely due to the location of the village rather than to the respondent's age or gender, unlike a previous study from the Arctic (Alessa et al. 2008) where older people had a tendency to report more change than younger people. Salick et al. (2009) further stress that climate change is not only an environmental, social, cultural or economic phenomenon but also has spiritual and moral aspects. In the Indian Himalayas, Vedwan and Rhoades (2001) examined how apple farmers in Himachal Pradesh,

Western Himalayas perceived climatic changes. They recorded impacts of climate change on blossoming, yield, fruit quality and increase of new pests and diseases. They further stressed on the importance of policies being more inclusive rather than being based on economic maximization alone. Chaudhary and Bawa (2011) studied indigenous knowledge about climate change and its consequences for biodiversity and agriculture in the Darjeeling Hills region in the Eastern Himalayas with one of the largest sample sizes for such a study. Chaudhary et al. (2011) and Chaudhary and Bawa (2011) confirmed numerous weather and ecosystem-related indicators as well as biodiversity and agriculture and livelihood based climate change indicators and suggested that people at higher altitudes appear more sensitive to climate change than those at low altitudes. The study highlights the importance of documentation of local knowledge and its use in policy to combat the numerous cascading impacts of changing climatic conditions.

CLIMATE CHANGE AND ADAPTATION:

"In 2007, at the Environmental Change Institute in Oxford, UK, researchers from different disciplinary backgrounds from the humanities and social sciences to the natural and physical sciences, as well as representatives of academic, research, and non-profit organizations gathered to discuss how indigenous and other local people are affected by global climate change, and how they perceive and react to these changes. The focus was not only on the plight of indigenous peoples, but also on their resourcefulness and active responses to climatic variation"- Jan Salick and Nanci Ross (2009).

Communities are not just passive observers but they actively adapt to the new conditions resulting from changing climatic conditions (Salick & Byg 2007; Macchi 2008). Indigenous people are coping with loss of biodiversity and adapting to climate change through numerous strategies such as migration, irrigation, water conservation techniques, land reclamation, changing when, where, and at what elevation plants are cultivated and livelihood adaptation to name a few (Macchi et al. 2008). Another example is how communities equipped with traditional ecological knowledge have developed numerous ways to deal with unseasonal floods which are one of the many effects of climate change, often caused by erratic and unpredictable rainfall. Adaptive or preventive measures arising from years of tried and tested techniques include riverbank retaining walls, terracing, bio stabilization of slopes (using rocks and native plants) and other techniques to counter the effects of floods. These measures are also used to reduce damage from landslides, rock falls and mudflows. In this manner indigenous people have developed several techniques using traditional ecological knowledge and their customs to "evolve fine tuned social systems" to cope with the ills of natural hazards. (Xu and Rana 2005; Byg and Salick 2009).

While studies on the contribution of traditional ecological knowledge of indigenous people to climate change research are still few, the contributions of traditional ecological knowledge to understanding and interpreting ecological processes, and for use in environmental and social impact assessments are widely acknowledged (Berkes 1999; Huntington 2000). Bridges and McClatchey (2009) outline how the traditional ecological knowledge system of atoll dwellers in the Pacific allow them to observe and respond to subtle climate changes that have local impacts which could provide a model for global responses to climate change. In the Himalayas villagers have started growing new crops which they could not before, which has enhanced crop diversity and in turn local diets in high altitudes, which could mitigate the effects of climate change on livelihoods and help people adapt (Chaudhary and Bawa 2011).

PRELIMINARY DATA FROM LACHEN VALLEY – NORTH SIKKIM:

Lachen Valley is located within the Eastern Himalayas that is a part of one of the 34 global biodiversity hotspots (Myers et al. 2000), within the administrative boundary of North Sikkim district in the State of

Sikkim. The alpine zone of Sikkim falls in the transition zone of the biogeographic zone 2C-Central Himalaya and the extreme southern fringe of the Turkmenian subregion of the Palaearctic region (Rodgers and Panwar 1988). Lachen literally means “Big Pass” in the local Lachenpa dialect. It has a steep gradient with elevation levels from 6560 ft amsl to about 23000 ft amsl.

The region is inhabited by two indigenous communities namely the transhumance Lachenpas and the nomadic yak herders or Dokpas whose combined population would be less than 1300. They are directly dependent on the biodiversity of their surroundings for livestock grazing and collection of medicinal, aromatic and edible plants (Tambe and Rawat 2009; Richard 2000; Singh & Chauhan 1997). Lachenpas and Dokpas are of interest firstly because the two communities are transhumance, moving with the seasons-the Lachenpas move to the higher altitudes in the summer and lower in the winter and the Dokpas or yak herders do just the reverse, moving to higher altitudes in the winter to the wind-blown, snow-free pastures. The relationship of both communities with their natural surroundings is thus very strong and they have a deep understanding of nature. This symbiotic relationship between their culture and nature has resulted in a wealth of traditional ecological knowledge based on their observations on the obvious link between changing climatic conditions and biodiversity.

Fig. 1: Dependency on livestock:

Fig. 1a: Dokpa making hard cheese for sale, Lachen Valley

Fig. 1b: Selling yak butter, Lachen Valley

Fig. 1c: Woman weaving yak fur carpets and man preparing yak tail for sale to tourists

Fig. 2: Livestock such as the yak play an indispensable role for the livelihoods of the Dokpas

Fig. 3: Sheep grazing in the winter grazing pastures above 5000 meters in North Sikkim

Furthermore, Lachenpas and Dokpas still maintain their indigenous political institution, the Dzumsa, which primarily manages the patterns of utilization of natural resources (Bourdet-Sabatier 2004). When the panchayat system was introduced into Sikkim in the 1970's it was not imposed upon the two valleys of Lachen and Lachung. Eventually the Dzumsa was officially recognized by the government of India in 1985.The Dzumsa is an annually elected body of 12 village representatives. It is composed of 2 pipons (or Headmen), 6 gembos (assiatants to the pipons/ executive), 2 Tsipos (accountants) and 2 Gyapons (messengers). This body represents the people of Lachen and manages resource utilization and conservation, pasture management for grazing, conflict resolution, social and community mobilization, and traditional and local governance. Over the years this institution has enabled the community a certain degree of resilience by adapting to the numerous changes in their socio-ecological systems due to social, economic and political transformations (Bourdet-Sabatier 2004), and most recently due to the cascading effects of climate change. In harsh conditions like the alpine Himalayas, social systems, or institutions like the Dzumsa play a vital role by regulating resource use in a way that prohibits over use and provides social, economic, and environmental security to the people.

Some examples of resource management strategies and implications are as follows:

The Dzumsa decides on the dates for migrating to new pastures as well the altitude below which they cannot graze so as to manage resources in grazing pastures, allowing enough time for grass in pastures to grow back over a season (summer) for winter grazing resources. They also set the dates for fodder collection along an altitudinal gradient so as to give equal opportunity for all to put up their winter reserves. The Dzumsa selects crops for different villages along different altitudinal levels to co-ordinate community level efforts and to give everyone time to repair fences that will protect their crops from freely roaming livestock. Furthermore this body decides the dates for sowing and harvesting based on traditional knowledge to ensure good harvests. Some strategies employed by the Dzumsa for economic security include fixing the prices of livestock and livestock products so as to protect the poorer members of the society as well as equal redistribution of money collected by the Dzumsa through fines, government contracts and other sources. At the time of funerals

members of the Dzumsa bring one bundle of wood to the house of the deceased and one log of regulated size to help the family at a difficult time.

Fig. 4: The Dzumsa (a unique traditional governing institution of North Sikkim) conducting a meeting

We conducted a series of household surveys in 2010 and 2011 to assess local perceptions of and adaptation to climate change in Lachen as part of a larger program on climate change in the Himalayas. When questioned about weather based indicators of climate change, almost all Lachenpas pointed out that snowfall has greatly decreased during the past 10 years. Similarly all the Dokpas interviewed also observed a decrease in the amount of snowfall. Many commented that where once there would be more than “5 feet” (1.5m) of snow outside their temporary dwellings, nowadays it is reduced to just a “couple of feet “or less of snow.” Both communities reported that the lowest altitude that received snowfall had shifted upwards to a village at a higher altitude. Similar results were recorded for an increase in overall warming, earlier summers, delayed monsoons and shorter winters.

Interviews with Dokpas also reveal that as a result of less snow, shorter winters (when pastures are snow covered) and erratic rainfall (heavier but shorter spells) the grass in the grazing pastures is drying up. The quality of grass in the grazing pastures is obviously of immense significance to the pastoralists who are dependent on their livestock. Pastoralists believe that the poor quality of grass has resulted in a large number of sheep dying; sheep are the weaker of their two main livestock, the other being the yak. As a result, Dokpas have started replacing the physically weaker sheep with more yaks as an adaptation strategy. Sheep have always played an important role in the Dokpas life but with drying up of grass in pastures and harsher weather conditions the Dokpas do not now invest much in sheep. The traditional governing institution, the Dzumsa had inturn noticed the drop in the supply of the sheep numbers. To maintain numbers and prevent price escalation of the costs of sheep, the Dzumsa banned the slaughter and sale of sheep for 3 years and lifted the ban in 2011. Thus we see how the Dzumsa has taken administrative decisions in response to the cascading impacts of climate change.

As described earlier the Dzumsa selects the crops to be grown at different villages along an altitudinal gradient. A number of new crops have been introduced that were previously unable to grow at such high altitudes these include maize, cabbage and pumpkin at Lachen (9000 ft amsl) and carrot at Thangu (12500 ft amsl).

With respect to biodiversity indicators of climate change, responses revealed altered phenology and range shifts in numerous species. For example, the Dokpas marked the onset of winter by the flowering of *Gentiana ornata* in their grazing pastures. *G. ornata* would be the last flower to bloom before snow covered their summer pastures. They pointed out that with the delay in winter season the flowering of the *G. ornata* species too has been delayed. Similarly they observed some plants species of lower altitudes that were previously never found at higher altitudes. We further cross checked this observed range alterations with secondary data from "The Flora of British India by Sir J.D. Hooker 1850- 1872 A.D." and also checked if Hooker was in the region during the flowering season through "Himalayan Journals Notes of Naturalist by Sir J.D. Hooker- 1850 A.D". We found range extensions for numerous plants that the Dokpas reported such as *Rheum nobile, Gentiana ornata, Bistorta macrophylla, Meconopsis grandi* and *Primula primulina* to name a few.

Fig. 5: The study has found range extension for plant species such as

Fig. 5a: *Rheum nobile*

Fig. 5b: *Gentiana sino-ornata*

Fig. 5c: *Bistorta sp.*

Fig. 5d: *Primula primulina*

The Dokpas also mentioned that the number of attacks by snow leopards on domestic livestock had increased, presumably because of less grass and poor grass quality, the yaks, especially the yak calves were weaker and slower making them more vulnerable to attacks. On being questioned about the presence of mosquitoes the Lachenpas unanimously responded that mosquito numbers have increased. Infact the respondents all agreed that till about seven years back no mosquitoes were seen in the Lachen area, suggesting that mosquitoes have been able to adapt to the higher altitudes owing to warming temperatures.

We also found that climate change has had a profound impact on the religious sentiments of the communities. The communities worshipped their surrounding mountains or mountain deities but with melting glaciers they believe that their mountain deities are unhappy or losing their power. This is best exemplified in the lines of Nima Gyamsen an aged Dokpa who lamented about the melting glaciers and said "*The Mountain's have been reduced to old balding men, with just a few white hairs* (snow cover) *left at the top. We worshipped the mighty snow clad mountains, alas our God, our culture is threatened*".

CONCLUSION

Climate change may be one of the biggest threats of the 21st century. Both mitigation and adaptation measures should be pursued to tackle the problems of climate change. However, during academic and policy debates in the past, more attention has been devoted to mitigation than to adaptation. While the significance of mitigation strategies cannot be underestimated, climate change impacts such as an increase in global temperatures, sea levels rise and extreme climate events (Raper et al. 1996; White and Etkin 1997; Wigley 1999) are likely to continue even if emissions are appreciably reduced (Solomon et al. 2009). Thus adaptation strategies remain important. Indeed, sensitivity to the issue of adaptation has grown over the recent past after the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report was issued. Now, the development of planned adaptation strategies is regarded as a necessary complement to mitigation actions (Burton 1996; Smith et al. 1996; Parry et al. 1998).

The ability to adapt to the effects of climate change will vary among countries, regions and socioeconomic groups, as well as over a temporal scale. "*Given that the natural resource-dependent poor are also the most vulnerable, reducing vulnerability may require a flexibility and people-centric dimension that only highly decentralized, democratic and environment-friendly system of governance can ensure*" (Gadgil and Lele 2009).

We need to acknowledge the obvious links between indigenous knowledge and climate change adaptation. Indigenous communities that have been adapting to various stresses for centuries and more recently to climate change impacts, as has been shown in previous sections of this chapter, have the ability to adapt or help themselves (Salick and Ross 2009). Perception studies of indigenous people on changing climatic conditions in various parts of the world have demonstrated that traditional knowledge, local observations and experiences are important sources of information for climate sciences (Berkes et al. 2001; Reidlinger and Berkes 2001; Nicolas et al. 2002; Bridges and McClatchey 2009; Byg and Salick 2009; Turner 2009; Chaudhary and Bawa 2011). In a region like the Eastern Himalayas with limited literature available on the impacts of climate change, the indigenous communities and their wealth of traditional ecological knowledge could be used as an important tool in complementing scientific studies.

Apart from traditional knowledge, local institutions will have an important role to play in countering climate change. The Dzumsa of Lachen as a local institution has proved to be very sagacious while overcoming the adversities brought in by climate change. Local institutions empower communities to rapidly respond to environmental change that threatens their traditional livelihoods, economies, practices and lifestyles. Thus to effectively tackle climate change, local perceptions, adaptations and institutions must constitute an integral component of national polices and action plans.

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Dokpa woman at Lhonak Valley. Dokpas are nomadic yak and sheep herders inhabiting the high altitude alpine pastures of Lachen and Lhonak Valley. Traditional knowledge, local observations and experiences of indigenous people like the Dokpas are important sources of information for climate sciences

Photo courtesy : Sandeep Tambe