

# Mountain Forum Bulletin

January 2008



## Climate Change in Mountains: Impact and Adaptation

- ▶ Intangible Ecologies: Sacred Mountain Landscapes in a Changing Climate
- ▶ Climate Change Impacts: Winter Tourism Adaptation Strategies
- ▶ Effect of Climatic Change on the Endangered *Dracaena Ombet* Tree in the Gabel Elba Protected Area in Egypt
- ▶ Experience of a Herder's Life in Western Bhutan
- ▶ Climate Change: Opportunity or Threat in the Central Andean Region of Peru

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*Glacier at Gaumukh, Uttarakhand, India.* Photo: G.Areendran  
*Tribal settlements in Kurangani Hills (Mudhuvakkudi, Muttam hamlets).* Photo: P. S. Bose  
*Beech (Fagus sylvatica) tree line in the East Carpathians.* Photo: V. Kricsfalusy  
*Snow cover decrease and climate change, French Alps.* Photo: Guillaume Prudent

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# Editorial

Welcome to the January issue of the Mountain Forum Bulletin. Reflecting the theme of the International Mountain Day in December 2007, this Bulletin focuses on climate change, but this time, looking at the impact and adaptation that has occurred as a result.

Climate change is impacting the mountains in many different ways. From the impact on sacred mountains, to the world of tourism, where winter sports are threatened due to the lack of snow. In many mountain ranges, climate change is affecting the species of plants and animal life that are living in already fragile ecosystems. Climate change in mountains particularly impacts communities, dependent on traditional methods of farming and crops that they now find hard to grow. Recognition and awareness of climate change has helped communities where they are changing the methods and crops they grow and so are adapting to the changes.

As always, members of the Mountain Forum are very active with initiatives around the world that are contributing to preserving the environment, increasing awareness of mountains and development initiatives that help mountain communities. We take a look at encouraging project in Argentina, where solar cookers are being used by mountain villagers. In the face of the environmental damage posed by production of artificial snow to feed the ever hungry tourism industry in the Alps, Mountain Wilderness is working to campaign and raise awareness about the damage being caused. Another member describes a wonderful project in Pakistan, where now for the last few years there have been children's camps, each year taking over a hundred children from all over the country to the mountains for 10 days to learn about the mountains and the environment and to work on small projects. A similar project in India does great work in positively engendering in the young people an appreciation of mountains, the environment, communities who live there and can only help for the future. These are just a few examples of the initiatives that members - individuals and organisations - are working on.

On behalf of the Mountain Forum community, I thank very much everyone who has contributed to share their knowledge and experiences, without whom, this edition of the Bulletin would not have been possible.

Yours sincerely,

Marianne Heredge



Dear Mountain Forum Members,

As the Executive Secretary of the Mountain Forum, it is a great pleasure for me to introduce you to the January issue of our Bulletin, which is focused on adaptation and the impact derived from climate changes in different mountain places of the world.

Raising awareness and information sharing are important elements to assist mountain communities in the challenges they are facing due to climate changes and the Mountain Forum has been assisting this process throughout the year as part of a coordinated awareness campaign with mountain development organisations. Hence, the past two issues of the Bulletin have focused on the topic of climate change.

Awareness, however, is not enough and action is required to achieve positive impact in the life of mountain communities. The Mountain Forum has a key role to convert awareness into action. This bulletin includes a valuable selection of experiences of positive impact derived from climate changes from our members from different mountain regions.

On behalf of the Mountain Forum Secretariat, let me take this opportunity to express my gratitude to my colleague Marianne Heredge for her wonderful role to put together the current issue of this Bulletin with a rich selection of case stories from different continents in a very timely manner.

The next issue of our Bulletin will focus on the topic of conflicts and issues derived from unbalanced management of resources in mountain regions, including gender issues. We encourage our members to share their experiences with us, enriching the content of the Mountain Forum Bulletin.

My deepest gratitude goes to our members contributing case studies and stories from all over the world. Thanks to their contributions, the Mountain Forum will continue playing a key role raising awareness, sharing information and harnessing resources from different mountain regions of the globe.

Sincerely yours,

Dr. Ana Maria Ponce  
Executive Secretary  
Mountain Forum



Your feedback is precious to us. Please write in with your comments to [bulletin@mtnforum.org](mailto:bulletin@mtnforum.org). You can also write to us by regular post at the address provided on the back of the Bulletin.

## Intangible Ecologies: Sacred Mountain Landscapes in a Changing Climate

Jonah Steinberg



Glacier at Gaumukh, Uttarakhand, India. Photo: G. Areendran

The potential implications of climate change for culture, sacred landscapes and human spiritual activity receive little attention from the media, the scientific community, or the public. However, most of the world's cultures place significant value on landscapes which depend on fragile ecosystems. In many cases peoples act as stewards and protectors of such ecosystems; their cultures and beliefs depend on the landscape and its particular form. Often the landscape depends on their maintenance and protection of it, especially in a rapidly-changing world. How will this change affect human interaction with the environment? What age-old knowledge and practices will be lost?

Mountain environments and the societies that inhabit them are profoundly impacted by global warming. This impact threatens not only to destroy the natural environment but to change the very nature of belief and ritual and even to alter sacred practices in these places. However, local knowledge can be tapped and mobilised in the service of conservation and environmental protection. Local communities are likely to be motivated activists and they know the landscape better than anyone else. They can thus work in close partnership with scientists and conservationists. Moreover, heightened awareness about the destruction of mountain ecosystems can help to motivate a wider concern for the survival of their cultures.

While it is sometimes large corporations or states that directly threaten mountain peoples' societies, the perpetrators are more often invisible and their effects on mountain environments are indirect. Thus the action that can be taken by mountain peoples to protect the environments they consider sacred must often take the form of publicity about their plight. Sacred mountain sites and landscapes hold a great deal of potential for generating awareness about climate change. In them we

find a unique nexus of culture and environment through which it may be demonstrated how global warming affects people and culture.

### Impacts

How does climate change transform human interaction with sacred mountain landscapes? Potential effects of climate change are of course diverse. To begin, changes are likely in the form, appearance and status of sacred lakes. This may include a potential water-level rise or, in the case of increased aridity or over-irrigation, an evaporation and fall in water levels. A related process is decline in the size of snowfields and glaciers associated with high-altitude sacred sites or with local beliefs about sacred mountains. A change in vegetation and greenery, whose intensity is often associated with particularly special sacred sites, could also be a culturally-relevant impact of climate change. Among transhumant cultures, we might see a different range of seasonal or daily movement between village and pasture, defined by snowmelt and therefore in altitude-based zones of purity such as those found in Northern Pakistan. Other environmental processes salient for cultural interaction with the landscape include deforestation, including that in highly-valued jungle and forest areas; desertification, including formerly verdant mountainsides; change in the course and water level of important and revered rivers; and the disappearance or diminution of certain animal species associated with spiritual beliefs and practices.

A thorough field examination of these dynamics would require an exploration of indigenous explanations for global warming, involving an in-depth ethnographic and ecological analysis of (1) local cultural perceptions of climate change; (2) above and beyond perceptions alone, the way that climate change has led to adaptations in behaviour and practice; and (3) the actual ecological changes that have occurred and are likely to occur.

### Examples and manifestations

While research on the topic is scarce, it is not hard to find real-life examples of the many ways that climate change is likely to affect cultural interactions with the landscape. Examples of actual impacts of climate change on sacred landscapes, discourses and perceptions of such change and strategies and solutions for dealing with it are abundant. For example, the Amarnath Cave in Kashmir houses an ice lingam associated with Shiva. A yearly pilgrimage, a yatra, has as its destination the cave. Climate change has purportedly been associated with a diminished lingam. In the past two years, there was reported to be insufficient snowfall which, coupled with glacial recession, failed to form a full-fledged lingam. In 2006, a lingam suddenly appeared which some believed to have been fabricated. In 2007, only a very small one formed, which then melted before the yatra began. While there has been some controversy on this matter, locals and yatris have blamed global warming. The important point here is, in part, the perception of the role of climate change in the realm of the sacred.

Peru's Qolqepunku Glacier provides us with a particularly interesting example of the nexus between global warming and sacred mountains. The Wall Street Journal of 15 July 2005 ran an article entitled "The Ukukus Wonder Why a Sacred Glacier Melts in Peru's Andes: It Could Portend World's End, So Mountain Worshipers Are Stewarding the Ice." A Quechua traditional pilgrimage of some 40,000 people, called El Señor de Qoyllur Rit'i, involves climbing to 16,000 feet to harvest large blocks of ice from a glacier to use as part of a festival. The glacier has retreated 600 feet recently and its retreat is visible by the year. To appease the apu mountain gods here, pilgrims are now

forbidden to extract ice from the glacier. They believe that the disappearance of the glacier is associated with the mountain god's departure. The water derived from the mountain's ice is thought to have magical healing powers and to form the apu's semen for the fertilisation of Mother Earth (Pacha Mama). Some indigenous Peruvians are said to associate the loss of snow from mountain peaks with the end of the world.

In a similar situation in Northwest Yunnan, the sacred Mingyong Glacier (Kawagebo to Tibetan Buddhists) on Mount Khawa Karpo (Meili Snow Mountain), whose presence is heralded by long threads of prayer flags, is disappearing. The Nature Conservancy points out a retreat of some 200 meters in four years, with an increasing shrinkage rate. Mountain trees are slowly moving up the slopes. The area faces not only the disappearance of the glacier but also threats to the villages down valley. The Nature Conservancy is working with villagers to adjust their activities in alpine areas to changing conditions.

In India, the sacred Ganges river is threatened by glacial retreat. The Washington Post ("A Sacred River Endangered by Global Warming," 17 June 2007) points out that the glacier at Gaumukh-Gangotri supplies about 70 percent of the river's water and that it is shrinking by about 120 feet per year. Predictions hold that the river will eventually become seasonal. As can be expected, many Hindu environmentalist movements have emerged around this issue.

A Mountain Forum electronic discussion points to a very interesting indigenous approach to climate change. In Northern Pakistan, the practice of artificial glacier grafting, in order to create a new glacier, is widespread. The conditions for this activity are very particular, and local people are beginning to understand and describe it as a counteracting measure to climate change. Glaciers provide water through ancient carved slope-side channels in these areas. Such practices as glacier grafting, and their preservation are essential for the provision of water in arid areas and are excellent ways to think about indigenous practices which can resist global climate change. Many of the contributors to the discussion board from a number of mountain regions explicitly tied the practice to the attempt to take action against global warming and made observations about the ways that it has changed in the context of climate change.

## Strategies, approaches, and solutions

Mountain societies and the organisations that work with them are not powerless to do something about this catastrophic transformation. It is imperative that experts on and advocates in mountain areas begin to imagine and devise possible solutions and approaches to address the cultural implications of climate change. Potential awareness-generating activities and effective strategies for advocacy can be modeled on past successes. Indigenous reforestation and ecological restoration programs such as those pursued by Chipko in India or the WWF in Northern Pakistan, have proven powerful. National Parks can be an excellent vehicle for demonstrating the natural and cultural value of landscapes and the mobilisation of sister park relationships between national parks can exploit the solidarity inherent in that partnership. Sister park relationships can provide a forum for mountain peoples to share a common experience and network common solutions, and for wider public audiences to learn about mountain areas.

Other effective solutions may include publicity campaigns demonstrating the loss of cultural heritage, which will accompany ecological destruction and sustainable tourism programme raising

money for and enhancing visibility of the struggle of cultures whose landscapes are being changed by global warming. Perhaps most promising, however, are programmes which empower local societies to take action against climate change. Local inhabitants of affected areas can be mobilised as stewards of the environment, with motivations for such activity couched in terms of cultural beliefs on sacred landscapes. Moreover, educational programmes by local inhabitants of threatened landscapes for outsiders, explaining methods for sustainable resource use and reasons to protect the environment from their perspective to generate concern among outsiders. Such programmes highlight the inseparable and intimate connection between people and landscape, between natural and cultural ecologies; they show that the fate of the environment and the fate of human habitats are inextricably intertwined. Stewardship of one is stewardship of the other, and both demand our attention.

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The Mountain Institute's mission is to advance mountain cultures and preserve mountain environments. Core initiatives include conserving high priority ecosystems in the Andes, Appalachians and Himalaya mountain ranges, promoting environmentally and culturally sustainable livelihoods for mountain communities and supporting the Mountain Agenda through advocacy, education and outreach for mountain communities.

## Resource Conflicts in Mountains: Sources and Solutions

*Carmen de Jong*

Conflicts in mountains develop when different needs compete with each other over limited space and time and on a more severe level, when international boundary issues arise in remote areas. From a political and geographical point of view, mountains represent a special environment in terms of topographic, social and economic constraints. Increasing pressures induced by anthropogenic change and uncertainty of climate change foster the emergence of double-loop conflicts. These characteristically develop at the local scale. Often conflicts occur at the interface between traditional,

primary activities and new developing economical activities that have a less environmentally sustainable approach towards natural resources. Nowadays the strain on sharing resources accelerates the tip-over point towards conflicts.

In this article, the sources of conflicts will be analysed, a case study of conflicts between a farmer and the tourism industry described and possible conflicts resolutions and prevention suggested. The conclusion summarises the current dimensions of the conflicts.

### Sources of conflicts

There are many sources of conflicts in mountains and they have a number of common sources. Conflicts usually occur when some or all of the physical, ecological, societal, cultural and economic fields confront each other. In the absence of shared knowledge of problems and/or consensus major distress, resource shortage or even war can result. For example in the year 2000, 18 of the world's 28 armed conflicts took place in mountains (Smethurst, 2000). Conflicts characteristically occur at a very small scale, as a result of increasing population pressure or from new problems associated with climate variability and uncertainty. They are typically caused by a lack of cooperation between the public and private sector and enterprises as well as opposing economic and ecological values. Moreover, long term versus short term visions can hide the dimension of a conflict.

### Cultural, societal and ecological sources

In the Himalayas, conflicts have developed between natural resources, private enterprises and government policies. For example, areas that have been transformed into nature reserves can no longer be exploited for gathering natural medicinal herbs or for allowing tourists to traverse certain areas, so that the livelihood of local people is menaced.

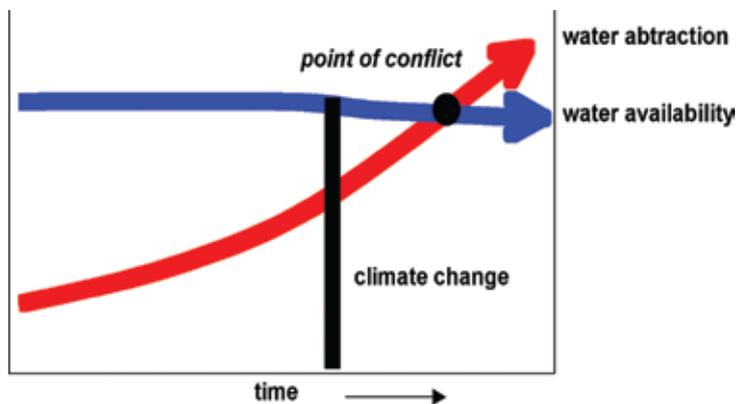
Other societal conflict sources include population migration and immigration, resulting in population deconcentration and concentration and unequal age distributions linked with growing expectations versus needs (Zucca 2006). In this situation, new incoming populations can menace the cultural or economic values of local communities. Conflicts often develop where there is a lack of awareness, perception, understanding, acceptance and evaluation of different needs or a lack of information and communication. Indeed, stereotypical conservative approaches versus stakeholder participative approaches often result in clashes.

### Physical, ecological, economic sources

Often it is the limited availability or misuse of natural resources that leads to conflicts, in particular where demand is higher than offer. Thus, for example, in order to maintain and ameliorate the tourism industry in mountains, more and more local natural resources are exploited (Hudson, 1996). Since climate change is simultaneously changing the supply of water and snow and the demand of the tourism industry are steadily increasing, more and more water resources have to be exploited to produce artificial snow to compensate for the decreasing supply of snow resources (de Jong 2007 b). Increasing water consumption by tourism is already putting a high pressure on water resources in addition to water-intensive techniques compensating for lacking snow, leaving less available for local communities and tourist resorts (de Jong 2007 a). At the same time, climate change is causing greater variability of water resources in the winter months, so that less is available for the different activities. Finally, once the



Preparatory works for the construction of an artificial reservoir (125,000 m<sup>3</sup>) at Ariondaz (2,500 m) to store water for artificial snow making for the ski lifts of Courchevel, French Alps. Photo: Benjamin Damelet



Model illustrating conflict development based on water demand and supply in mountain regions. Graph: de Jong

demand for natural resources associated with these economic activities has surpassed the threshold of supply, a lack of the resource occurs and a conflict develops. An additional strain is imposed on the aquatic ecosystem when the minimal ecological discharge is not respected during times of water conflicts. Since mountains are important water suppliers for the lowlands

(Viviroli et al 2003) water conflicts in the upper catchments may have far-reaching impacts.

Other examples of conflicts concern land claims for pasture versus tourism infrastructure, such as housing and snow making infrastructure. The zonation and disintegration of core zones may involve conflicts with wildlife habitats. Other types of conflicts commonly develop between the requirements for minimal ecological discharge and the discharge artificially regulated by hydropower and energy prices.

## Case study of conflict between farmer and tourism industry

An actual example of a conflict in mountains is the case study of Courchevel, French Alps. Here a conflict has arisen over pasture size and quality between an alpine farmer and the tourism industry, more specifically the ski lift operators of the Trois Vallées (Casanova 2007). With the increasing uncertainty of snow depth and duration due to climate change, more and more artificial snow is manufactured to compensate for lack of natural snow. This requires ever increasing amounts of water, which is increasingly derived from the explicit construction of artificial reservoirs. In this case study, two major points are associated with the conflict. The first concerns the surface area occupied by the construction site of a large artificial reservoir (125,000 m<sup>3</sup>) that is being built to store water and fabricate artificial snow in a snow factory at 2,500 m. The water for the reservoir will be pumped up from the Rosière dam (1,500 m) and also fed from the reservoir of Biollay at 2,000 m. Although the reservoir was estimated to cover only two hectares, the farmer who rents the land for grazing his cattle on the high altitude pastures in summertime estimates that between 10-15 hectares of land were rendered unusable for grazing. Due to the reduction in grazable land, the farmer had to reduce 25 percent of his herd and thus suffered a loss in milk production worth 30,000 Euros.

The second point concerns the dust emitted by the building site which has caused spores to settle on the grass which are ingested by the cows and thereby enter into the milk. Once the milk is heated, the spores start to develop and destroy the cheese, a process often only perceived after several months. The dust from the building site contains approximately 30

times more spores than usual. The conflict was brought to the attention of the ski lift operators and the local community by the farmer and a monetary compensation is under discussion. The region has invested 7 million Euros into this reservoir infrastructure. However, the conflict is not only temporary, since the pasture that was removed over a large surface to build the artificial reservoir will not grow back quickly in this type of fragile environment. Also, in future 900,000 m<sup>3</sup> of water will be available per year for snow making from the reservoir and it is questionable whether there will be sufficient water available at the right time of the year for the agriculturalist.

## Conflict resolution / prevention

Conflict identification, prevention and resolution remains one of the most difficult tasks. Some issues that are important for resolving conflicts include the development of awareness, perception and responsibility within the society, the creation of opportunities for multi-stakeholder discussions, effective communications and planning, the creation of actual and potential scenarios for the relativisation of conflicts within their environment.

## Conclusion

One primary problem of conflicts related to climate change and population pressure in mountains is the social denial of the problem (Norgaard 2006). Scale comparisons dominate and conflicts are often trivialised locally due to oversimplified statistical or sectoral comparisons. Although sources of conflicts are frequently known, the problem is often ignored and an adaptation strategy resembling as much as possible the business-as-usual-scenario is selected. This often occurs independently of the environmental or economic cost-benefit considerations.

## Acknowledgements

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## Climate Change Impacts: Winter Tourism Adaptation Strategies

Guillaume Prudent, Emmanuelle Marcel-Poil and Vincent Boudières



Snow cover decrease and climate change, French Alps. Photo: Guillaume Prudent

Snow cover plays an important role for the mountain environment, representing a living area for some species, a huge water storage function, etc. While in the past it was seen as an obstacle in the European Alps because farmers could not work their fields or the passes were more difficult to cross, in the 20th century it became an important source of wealth and was even nicknamed "white gold". Indeed, snow represents the primary resource for winter tourism in the French Alps.

Tourism development in the European Alps has passed through different stages, from the early village-stations of the 1930s to the high mountain resorts of the 1970s. In France, ski resorts were mainly built for and around a unique activity: skiing. This tourist orientation, implemented through strong State intervention since 1960 is known as the "Plan Neige." When winters with reduced snow cover occurred, managers and investors became worried and looked for solutions to protect this mono-activity at any price. Artificial snow was slowly introduced in the mid 1980s and has evolved from a marginal item to an indispensable tourist marketing tool today. While in the past, resorts were advertising the number of square kilometres of skiing area, today they advertise the number of hectares of artificial snow.

Assessment of snow cover evolution is subject to uncertainties because of the restricted number of studied sites. Climate change projections are characterised by uncertainties and these uncertainties are strongly increasing when looking at the regional impacts of climate change (Jones, 2000). Snow cover evolution under a changing climate is also associated with uncertainties. Since uncertainties are everywhere, what do we know?

In France, the main experimental station for snow cover assessment is located in the Chartreuse massif (Col de Porte, 1,360 m). At this station, a very significant irregularity has been observed for the month of February between 1960 and 1990. Despite strong interannual variability, the general trend is a decrease in snow height, especially due to low snow cover in the 1990s; throughout the 1990s, snow height only once exceeded 1.5 m per year whereas it was 3 or 4 times this value in the preceding decades (Etchevers & Martin, 2002). This snow cover decrease is concordant with observations in the German Alps (Hennegriff et al., 2006), the Italian Alps (Cat Berro & Mercali, 2007) and the Swiss Alps (Beniston et al. 2003, Beniston 2005).

While snow cover is projected to retract at the global level because of global warming (IPCC 2007), this statement does not provide enough accuracy for local policy makers and ski resort managers. However the evolution of snow cover with climate change in the French Alps is being studied with the development of a snow cover model, SAFRAN/CROCUS, coupled with the ISBA surface scheme (See Météo France/ CEN web site for details).

This model calculates that for a 1.8°C warming, at around 1,500m, the mean snow cover duration should decrease by one month (from five to four months duration). Snow height should decrease by around 40 cm in the Northern Alps (from 1 m to 60 cm) and by around 20 cm in the Southern Alps (from 40 to 20 cm). Above 2,500 m snow cover duration should decrease slightly (around a dozen days per year), as well as snow height (Etchevers & Martin, 2002).

Despite rigorous scientific analysis (and due to the quality of this analysis), the uncertainties remain significant. In this context where, by the end, we have limited certainty in future projections for a ski resort scale, what kind of action has already been implemented and how is adaptation for ski resorts considered?

### Winter tourism adaptation strategies

For winter tourism, the climatic risk is strongly associated with a lack of snow cover which has led, for some time now, to the implementation of various adaptation strategies (artificial snow, implementation and development of altitude sites, tourism diversification etc.). These strategies are driven by public actors (Nomenclature d'Unités Territoriales Touristiques - NUTs 1, 2,

3, 5) but also by private actors (tour operator NUTs 5), and have been implemented before the current stream of climate vulnerability awareness.

Nowadays, climate change is considered and comprehended as a risk. Thus it can generically be conceived as follows: Risk = F (unknown factor, vulnerability), where F is a function depending on means of analysing the problem (Dauphiné, 2001). Thus, using this kind of approach and considering the uncertainties associated with this risk, climate change can be seen as a problem scientifically exposed or politically built (Gilbert, 2003). However when analysing the strategies developed by the public and the private actors, uncertainties are not adequately taken into account whilst scientists point out these uncertainties. Then, there is the development of a dominant conception of the problem and especially of the local impacts understanding despite the strong uncertainties associated with climate change regional impacts assessment.

The lack of reliable snow cover for ski resorts, closely linked to climate change, generates a pretext to act urgently rather than considering the long term impact of climate change on snow cover height and duration. This pretext to act urgently is undertaken to maintain and preserve a tourist economy considered to be under threat. Here, the uncertainty associated with the problem is not an obstacle for acting. Furthermore, in the name of the "precautionary principle", actions aiming to reduce the impacts, despite limited knowledge (especially about artificial snow), are multiplying and are often funded by the private operators themselves. Thus, there is action that is developed within a determinist conception of climate change risk and leads to solutions, or so-called adaptation measures, which are not very well coordinated and even antagonistic to a general logic of maintaining the existing touristic and economic activities. Depending on the actors considered, strategies are varied and the results can be presented as follows:

- Diverse approaches and strategies developed to cope with climate change taking a dominant and hegemonic view of the problem. This variability is especially due to the economic weight of winter tourism for the Nuts 3 level, but they also depend on the type of ski resort: village, integrated, Middle Mountain (1,200-2,000 m) or High Mountain (> 2,000 m).
- Lack of coherence and synergy in the developed actions, especially for public policies. The political autonomy of the territorial levels (NUTs 2, NUTs 3, NUTs 5) generates a lever effect per territorial level. Indeed there is no process harmonising the developed policies and there is no action program on both the vertical and horizontal scheme.
- Furthermore, the closer to the intervention in the tourism territory, the more the strategies developed are in a short term (the time to recoup the ski lifts and the artificial snow installations). The local levels are trying to attenuate the impacts with circumstantial adaptation rather than imagining and developing adaptation strategies dealing with the mountain winter tourism structure. Adaptation strategies dealing with the tourist structures (for example no more subsidies allowed for ski resort equipment and the implementation of public policies encouraging activity diversification) are long term and are carried out by the "not-so-local" territorial levels, less concerned by the economic risks taken.

In France, there is in a general sense, a strong determinist conception of the climate change problem threatening the mountain tourism territories. But the analyses are showing that the determinism is not associated with the external threat but

rather with internal threats (i.e. the vulnerability of the tourist model - wide mono-activity ski resorts - and the weakness of the solutions - incoherence and lack of harmonised strategies). The divergences between short-term and long-term strategies, but also between national and local strategies highlight the duality of the problem. For some actors, it is a question of snow cover reduction, but fundamentally it is also a problem originating from the organisational and structural vulnerability of the tourist economy and the associated public policies.

### Conclusion

The climate vulnerability assessment for winter tourism is characterised by significant uncertainties. However, both policy makers and tour managers have to develop strategies now and have even already implemented some actions, without taking into account the existing uncertainties. These actions to cope with snow cover variability and climate change are mainly based on artificial snow equipment. In this context, climate change is now used as a justification to spread artificial snow equipment while the impacts on the environment (building of collinear artificial lakes, water waste and additives) remain unclear. This kind of strategy takes the priority over other potential strategies such as activity diversification. Furthermore, the artificial snow strategy (supporting a kind of winter tourism) is leading to a consumption of environmental and financial resources that might have been used for all year round tourism. Winter tourism adaptation should not lead to the degradation of the mountain environment and a decrease of tourism quality in the name of climate change.

(The opinion expressed and the arguments employed herein do not necessarily reflect the official view of the ONERC, Cemagref or the French Government.)

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The Observatoire National sur les Effets du Rechauffement Climatique or ONERC was created in 2001 to illustrate the willingness of the French Parliament and Government to deal with climate change issues. It has three missions: to collect and redistribute information concerning climate change impacts and resulting hazards; propose recommendations for climate change adaptation; and improve the climate change dialogue with developing countries, mainly through cooperation via the French Overseas Possessions, such as Martinique, Réunion, Austral Territories, Thaiti etc.

## The Impacts of Climate Change on the Alpine Biota: Management Adaptations in the Australian Alps

Roger Good

Modelling predictions have identified that the Australian Alps flora and fauna will be the first in Australia to be impacted by increases in temperatures and changes in precipitation regimes as a result of climate changes. As there is only a single alpine zone on the mainland and a smaller area on the island State of Tasmania, the Alps are a priority site for study and monitoring of the impacts and the responses of the biota. The marginal alpine climatic conditions that prevail, due to the relatively low elevation of the Alps (the highest peak, Mt Kosciuszko is only 2,228 metres) reinforce this priority. The minimum winter temperatures seldom fall below  $-15^{\circ}\text{C}$ , with the maximum precipitation being in the order of 3,000mm at the highest elevations. Snowfalls contribute approximately 60 percent of total precipitation, but it is extremely variable from year to year.

The area covered by snow for more than 60 days a year is only in the order of 2,200 km<sup>2</sup> on the mainland and 1,200 km<sup>2</sup> on Tasmania. Even a modest predicted warming ('best case scenario') of only  $+0.6^{\circ}\text{C}$  by 2050 will result in a predicted 27 percent reduction in the area that receives 30 days of snow cover per year (Hennessy et al. 2002), while under the predicted 'worst case scenario' a reduction of 93 percent will result for the areas having more than 60 days of snow cover a year. A

reduction in total precipitation cover of this scale together with increases in temperature and solar radiation (total UV) will have significant impacts upon the unique and biologically important flora and fauna of the region (Green 1998, Good 1998), as the biota will have no alternative refuge areas to which they can migrate. Mt Kosciuszko is 500-600 m lower than the theoretical nival zone, so there is little or no opportunity for an altitudinal shift in the alpine zone.

Two unique natural features will influence the degree and extent of the impacts of changing climatic regimes, these being the well developed soils and the origins of the alpine vegetation itself. An almost complete cover of well developed alpine humus soil extends to the top of the highest peaks, which contrasts with other alpine areas where soil development is minimal at the higher elevations. The deep soils have provided for the development of a diverse alpine vegetation with 230 herbaceous species (25 alpine endemics but only 30 are obligate alpine species). The alpine flora is a complex of species of indigenous species and species related to and having evolved elsewhere. The most detrimental impacts will be on the indigenous species and communities; the snowpatch, short alpine herbfield, sod-tussock grassland and bog and fen (mires) communities, while predictably, species that still occur at or evolved at lower, warmer and drier environments should be able to adapt to changes in temperature, snow cover, total precipitation, humidity, and solar radiation.

These alpine communities are the habitat for some 25 native mammal species which frequent and /or are dependent to some degree on winter snow cover. As with the plants many of the 25 mammal species, are also common at lower altitudes with two exceptions, the Mountain Pygmy Possum (*Burramys parvus*), found only above the winter snowline and the Broad-toothed Rat (*Mastacomys fuscus*), occurring above about 1,100m. No bird species are confined to the mountains but some 66 species have been regularly recorded above 1,500m in summer. (Green and Osborne 1994).

### Predicted impacts of climate change on the alpine biota

Predicted climate changes will affect the distribution of the plant communities and the obligate fauna, directly through changes in temperature, precipitation and increases in total ultraviolet light exposure as a result of reduced cloud cover, and indirectly through the depth and distribution of snow cover. The predicted, very much reduced snow cover will lead to an increase in the diurnal winter freezing and thawing of the alpine humus soils, with increased 'frost-heave' action in areas with exposed soils. A flow-on effect will be a decrease in organic matter decomposition rates and a resulting depletion of soil nutrients within the nutrient cycling regime of the alpine humus soils. The soil micro-fauna and invertebrates being important contributors to soil organic matter decomposition cycle will similarly, be reduced in number and activity if soil temperatures are reduced in the autumn and spring and increased in summer.

An increase in mean summer temperature and decreased rainfall may exacerbate and extend the periods of moisture stress that alpine plants have to endure, providing an ecological advantage to those species which are able to best adapt. Many of the latter will be exotic weed species. Part of this adaptation will be the capacity of species to tolerate higher levels of solar radiation, particularly the increasing levels of ultra-violet light. The latter has already been shown to have a detrimental impact on flowering and seed set of the Skye Lily (*Herpolirion novae-zealandae*), Marsh Marigold (*Caltha introloba*) and Sphagnum

cristatum and Corroboree Frog (*Pseudophryne corroboree* which inhabits Sphagnum bog areas). (Good and Green unpublished data).

Seasonal snow cover is recognised as the major determinant of the faunal composition of the alpine area above 1,500m (Green and Osborne 1994, 1998). In past years of shallow snow depth, reduced longevity and distribution of snow, records indicate a reduction in populations of the only species of native mammal that generally increase in number with altitude. The Broad-toothed Rat *Mastacomys fuscus*, numbers have declined in recent years as snow cover has declined (Green unpublished data), while the small Mountain Pygmy Possum *Burramys parvus* is already under threat of extinction, as a result of lowered recruitment and declining habitat (L.Broome pers. comm) due to reductions in the snow cover.

Locally migrating birds will predictably also be influenced in their migration timing and arrival times in the Alps by declining snow cover. Over the past three decades arrival dates for regionally migrating birds have been increasingly earlier and in recent years have been as much as six to eight weeks earlier than dates in the 1970s.



Figure 1. Pooling of inflows to saturate degraded and damaged peatbeds



Figure 2. Peatbed trenching and damming to slow drainage from peatbeds



Figure 3. Shading of sites of significant mire plant species.

The mire mapping has been undertaken by remote sensing while all the field works have been planned and implemented on an ecological basis. The additional water pooling in the influent and effluent streams provides a longer time-frame and a greater volume of water available for take-up by the peatbeds and subsequently, saturation of the peatbeds for longer periods. The trenching across peatbeds and the placement of dense layers of organic material (straw bales) in the peatbeds as a 'dam wall' assists slowing the rate of water loss through and from the peatbeds during prolonged drier periods, while slowly decomposing and becoming part of the peatbed itself. These peatbed 'structures' have been shown to assist the maintenance of peatbed saturation for up to 20 percent longer than mires without such structures (Figs 1,2,3).

Research has shown that herbaceous mire (bog and fen) plant species, particularly *Sphagnum* and *Empodisma* spp) grow more actively and survive drought periods better when 60 to 70 percent shade is provided by shrubs growing in or around mires (Good 2006). With predicted climate change leading to further loss of shrub cover, maintenance of significant areas of mire vegetation will require the implementation of other forms of shading (Fig 3). A number of sites have had commercially available shade fabric

## Alps management responses to predicted climate change

Several Alps 'climate change management' workshops have been held over the past five years to identify practical actions that can be taken immediately and to develop other longer-term climate change impact amelioration strategies. The most pressing requirement that has been identified is that of the protection, conservation and rehabilitation (enhancement) of groundwater communities (mires - bogs and fens). These communities have an ecological and functional role in the hydrology of the high mountain catchments and the major river systems they supply. A restoration and rehabilitation program was commenced in 2004, following extensive wildfires and prolonged drought. The field work to date has enhanced the capacity of many mire communities to adapt to changes in precipitation inflows and dry conditions, through improved storage capacity of the peatbeds and maintenance of the characteristic vegetation of the mires.

The program has involved the detailed mapping of the extent and distribution of all mires; the creation of additional storage pools in streams flowing into and out of the mires; the implementation of 'organic dam' walls within the peatbeds to enhance storage times and the placement of shade materials over significant areas of mire vegetation, particularly *Sphagnum hummocks*, to enhance growth and spread. (Good, 2006)

installed over them and very significant improvements in plant cover, species diversity and survival capacity in prolonged drought conditions have been recorded. These conditions are expected to increasingly prevail under predicted climate change conditions.

It has been identified that mires and associated communities that are degraded beyond restoration to their full ecological and hydrological roles, will require rehabilitation to an alternative but very different stable, self-sustaining 'natural' community, to ensure that the new community will have a potential to adapt to future climate change conditions. eg mires to herbfields and feldmark-like communities, ('erosion pavement feldmarks'). The techniques for this program were developed during the years of post-grazing rehabilitation of highly degraded alpine communities where erosion down to the underlying gravel substrate had taken place and restoration of the original community was impossible. Such programs in the future will contribute to a change in the area and distribution of the mires and several other communities but will ensure that the re-created communities will be better placed to adapt to and survive temperature increases and changes in precipitation regimes. Other communities may extend their range from exposed sites to more favourable or protected sites as a response to climate change, at the expense of the existing communities. Modelling, prediction and mapping of the possible / probable redistribution

of alpine communities is currently being undertaken to assist land managers to recognise and prepare for these changes in the redistribution of species and communities.

These examples of relatively simple programs implemented with an understanding of the ecological role and functioning of sensitive but important natural communities (mires), have shown that proactive field programs can provide an advantage to significant and / or threatened natural communities in terms of their capacity to adapt to and survive the potential impacts of climate change in the Australian Alps. The program will be extended to other sensitive and threatened communities in future years, as their ecological requirements are defined.

(Written on behalf of the Alps National Parks Mire Rehabilitation Team.)

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## Effect of Climatic Change on the Endangered *Dracaena Ombet* Tree in the Gabel Elba Protected Area in Egypt

Usama Ghazaly



*Dracaena ombet* tree, Egypt. Photo: Usama Ghazaly

It has been reported that the globally endangered tree, the *Dracaena ombet* of the Elba Mountains of Egypt is exhibiting widespread decline especially during the last 10 years. A detailed survey of the Elba Mountain area that lies between 450 m and 1,436 m of altitude inside the Gabel Elba Protected Area (GEPA), has been carried by the Gabel Elba Protected Area's rangers as part of the *Dracaena ombet* Monitoring and Assessment Project, funded by the Conservation Leadership Programs. The survey's results show that this decline is occurring and has accelerated at the lower and middle elevations of the *Dracaena ombet* range, with unhealthy trees, no sign of any new generation, pathogens affecting the trees and widespread tree death between 450-850 m. At higher altitudes, the *Dracaena* woodland in general is healthy, maybe due to a scattered distribution pattern for this tree at these elevations, rather than a grove-distribution as at the mid elevation, or maybe for other reasons. This altitudinal pattern of *Dracaena* woodland conditions

in the GEPA is very similar to that documented for the *Dracaena ombet* population of the Erkowit mountain in north east Sudan from about 50 years ago. We detected the effects of pathogens among most of the population of trees, but these do not appear to be responsible for the observed decline.

By reviewing the current conditions and also gathering the related traditional knowledge from local people from the Bisharia tribes, climatic conditions are seen as the main factors which affect the current status of the *Dracaena ombet* in the GEPA, which since 1996 has not received any rainfall except slight rain in November 2002. We suggest that the woodland decline is related in some way to climate change, where this is related to degradation of mountain habitats as a result of the extreme drought conditions and where also there is a shortage of natural resources, affecting local people in the upper zones where *Dracaena* grows. This leads to over-use of natural resources especially fuel wood taken from the acacia tree and other species. Resources are limited in the lower zones, in the wades and coastal plains and these areas show more signs of the effect of the drought than other areas.

It is recognised that most of places abundant with trees in the best condition occur in areas where the terrain consists of a solid rock pavement with extensive cracks, on north- east facing slopes, down which water and soil flow after rains, providing moisture and nourishment for the roots of the trees. These areas tend to be located on the western part of the Red Sea coast.

It seems likely that the main cause of the decline in extent and quality of *Dracaena* woodland is the gradual drying up of the area of southern Egypt. There is no direct historical data available from the GEPA about the distribution or status of *Dracaena ombet*, but there is strong circumstantial evidence that this area has been drying up over the last few hundred years. When comparing and matching available data about the extreme drought especially in the last 10 years with the available data about the distribution and status of *Dracaena ombet* in the GEPA during the last six years, it appears that probably this drought has had a great impact on the current populations inside the GEPA. As it is known, *Dracaena ombet* occurs only at a high elevation between 450 to 1,450 m in this area, which is affected by mists and cloud which come from the east, from the Red Sea coast towards the GE summit. Local people, traditional reports and the old explorers in this area have described the extent of this cloud/mist coverage diminishing over the years.

Resulting from the current extreme drought and climatic conditions, this area has turned into an evacuation area for people and livestock, where people have started to go down to the lower hills and closer to towns and villages. This means that the local settlements have become deserted and dead like the surrounding trees.

### Drought and its effects

Another potential threat to the *Dracaena ombet*, especially regarding its long-term survival, is the over-exploitation of acacia woods. With the gradual effect of drought, livestock production has also decreased, so local people have gone in search for new sources of income. People are now using the dead acacia trees, which had been used for many years as a traditional fuel source but in very small quantities among these tribes. Traditional uses have developed and rapidly accelerated into commercial use, with over-collecting and exploitation not only of dead trees, but also of live trees as a source of charcoal.

At present, local communities' traditional laws and knowledge in this harsh environment have broken-down as a result of the shortage of natural resources which have led to an unsustainable use of these resources.

At present, we can be assured that there are many acacia woodlands areas in the coastal plains and wades, but in the low and mid slopes in the GE there has been eradication and the ecosystem has been depleted, especially in the very sensitive ecosystems in the Elba mountains where the closely related *Dracaena ombet* occurs.

In the face of these harsh circumstances, there is an urgent need for understanding the local people's perspectives regarding this problem and working together to revive the old traditional laws which surely will play an important role in encouraging local communities towards more sustainable use of natural resources. In the *Dracaena ombet* conservation project in the GEPA, we agreed with the local people to set up and implement of a zoning plan for this area, including multiuse, restricted zones and also buffer zones to give the ecosystem an opportunity to become more resilient. Hopefully this will help in giving the *Dracaena ombet* a last chance for resistance against a rapid extinction in the Elba Mountains.

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## Climate Change and Philippine Teak – Mass Flowering Episode

Anacleto M. Caringal



Phenotypic expression of Philippine teak (*Tectona philippinensis* Benth. & Hook. f., Verbenaceae) as influenced by climatic vicissitudes in Lobo-San Juan Mountains (LSJM): (a) deciduous mother tree during summer (March-April); (b) mass flowering episode observed in 2000 (May-July) on the arrival of monsoon; (c) anthesis - purple blooms are seeds of life; (d) mass fruiting (mast) at mid-August; (e) matured pale-brownish drupes about to fall (August); and (f) teaklet - wild germinant burst in the forest floor after almost a year of dormancy. Photos: Anacleto M. Caringal

One intense summer day of April 2000, I observed from a nearby shore numerous defoliated medium-sized trees at the peak and along the slope of a low coralline hill in Sawang, Lobo Batangas. These leafless individuals, amazingly were still living. During the latter part of May, mass flowering of the same trees was observed in various villages in the Lobo Mountains, which encouraged me to conduct an inventory based on the solitary canopies bearing the mass inflorescence visible even from some kilometers away. In July, the white-purple inflorescence becomes pale-brown and begins to fall by August. By September the crowns are no longer prominently visible as fresh foliage is fully developed.

These trees in fragmented distribution up to 300 meters altitude in Lobo-San Juan Mountains (LSJM), form a century-old botanical treasure: Philippine teak (*Tectona philippinensis*), numbering as few as 4,300 specimens in the wild. It serves as protection forest along mountain gorges or relief that is susceptible to landslides and soil erosion. It also stabilises the coralline hills along the sandy shores and harbors wild orchids (*Trichoglottis* sp.) and wild Cycas, including rare Philippine birds and mammals.

As far as the carbon value of Philippine teak is concerned, approximately 103.5 tC is locked in the stand and is valued at USD 517.5 at USD 5/tC or Philippine peso (PhP) 28,462.5 based on the valuation made by Dr. Merlyn N. Rivera, a forest economist at the Ecosystems Research and Development Bureau (ERDB) - Department of Environment and Natural Resources (DENR), Philippines. But such market value is yet to be established. Nevertheless, just like any tree, it provides other services such as carbon sequestration, water holding capacity and nutrient cycling.

### Institutional appreciation

The first phenological study on Philippine teak was conducted in 1991 in Lobo by the Philippine's Protected Area and Wildlife Bureau (PAWB) and was reported by Forester Imelda C. Pangga of

the ASEAN Regional Center for Biodiversity Conservation (ARCBC) during the 2001 National Summit on Philippine Teak that was sponsored by the National Museum - Botany Division and Happy Earth Organization. Since then, no report has been made on the flowering of Philippine teak. Although flowering may have occurred since 1991, it may not have been observed. Philippine teak's importance was only recognised in 2001 by the local and national agencies such as the municipal governments of Lobo and San Juan and the Batangas State University (BSU).

### Mass flowering in response to climatic vicissitude

The Philippines' Weather Bureau (PAGASA) reports that the coastal province of Batangas, Luzon Island does not get a very pronounced maximum rain period, with a short dry season lasting only from one to three months. Under Thornthwaite, Moh and Schmidt's classification, however, the regional macroclimate is classified as Type D where the condition is generally dry. Rain is not evenly distributed with at most, six dry months. The normal microclimatic condition of Lobo-San Juan Mountains (LSJM), however, is pronounced having two seasons: dry (November-April) and wet (May-October).

Prior to the mass flowering in 2000, Philippine teak trees have been observed to shed in April or even earlier. On the onset of the monsoon (May-June), flower buds and new leaves start to develop and the species would be in bloom. The observed mass flowering and fruiting of Philippine teak which was not observed prominently during the previous years may be due to the after effects of the El Niño phenomenon in the Philippines during 1997-1998.

El Niño was first heard of in 1892 by a scientist named Camilo Carillo from fishermen in Port Paita of Peru who kept on talking about the "Corriente del Niño" or "Current of the (Christ) Child". Evidently, the fisher folk were referring to the warm water that occurred around Christmas, the date celebrated worldwide as the birth of Jesus, causing a sharp increase in fish catches. But the abundant catches lasted only briefly because subsequently the fish population declined sharply. El Niño is associated with extreme climatic variability characterised by weather disturbances or unexpected climatic changes such as absence of rains during the rainy season, or the occurrence of violent storms during the dry season. In other words, this global climatic abnormality can cause extremes: either prolonging the dry season or causing drought or excessive rainfall in short periods that can lead to widespread flooding in low-lying areas. In the past, Indonesia's 80,000 ha forest fire and North Korea's famine were manifestations of El Niño's presence in the Asia-Pacific Region. In the Philippines, its signals are a very low water table, a delayed onset of the rainy season, an early onset of the dry season, weak monsoon activity and fewer tropical cyclones (Diokno, 1997).

Flowering of Philippine teak may start normally during the onset of the rainy season (May-June) but the usual extreme and extended summer caused by El Niño may bring a delay in the flowering and mass flowering may be driven also by the effect of such phenomenon.

### Elsewhere in Southeast Asia

Mass flowering and the subsequent mass fruiting (mast) which is observed and reported in other tropical countries such as Thailand, Malaysia and Indonesia, is ascertained to be the direct effect of such climatic abnormality, which is highly associated with temperature, water stress, sunshine values, and canopy

position (Ashton, et.al 1998). The major El Niño events of 1951, 1953, 1957, 1968, 1976-1977 and 1982-1983 were accompanied by heavy mass flowering in many areas of Peninsular Malaysia and East Borneo in some species of rain forest canopies particularly the Dipterocarpaceous (Bauan and Evasco, 1995; Ashton, et.al 1998). According to Lisa M. Curran, assistant professor of tropical ecology at the University of Michigan, more than 50 different species of Bornean dipterocarp trees synchronise their bursts of reproduction to brief, intense periods and she ascertained the episode by the arrival of the El Niño. Curran and her research colleagues documented a rare reproductive strategy called masting. Four masting episodes were recorded during El Niño years from 1986-1999.

## Opportunity for restoration of Philippine teak population

Fruit maturity of Philippine teak is observed during the rainy season (July-August). Rain causes the matured drupes to fall on the ground. Further observation shows that the drupes remain dormant on the forest floor for almost a year and on the onset of another year's monsoon, the seeds burst from dormancy. During this event, hundreds of wild germinants (Fig 2f Teaklet) 3.5 - 6.0 cm long can be isolated and transplanted to a temporary nursery in order to save them from the desiccating effects of summer. After three years, the nursery adapted germinants (seedlings) can be adopted by the local community or can be re-introduced to the original habitat.

The local microclimatic regime in LSJM in the last four years has never been worse for both agroecological and natural forest landscapes due to the prolongevity of the summer which makes it difficult to maintain optimum environmental conditions for the species' survival. In fact, mountain farmers' rain-dependent fruiting of sugar apples (*Annona squamosa*), one of their main sources of income has been delayed in the last four years (2004-2007) due to the holdup of rains that then lasted for three to four months. This observation may indicate that this part of the Philippine archipelago is highly vulnerable to climatic abnormality. Normally, the monsoon comes in early May with the highest rainfall in the months of July to October (ERDB, 2004). Despite this, the mass flowering observed in Philippine teak once the monsoon arrives can be advantageous for the species' perpetuation at least in its natural distribution. But to what extent? Teaklets are desiccated every summer under their leafless mother trees and they are gone forever. Their chances of survival are as small as they are.

The cheapest way of forest restoration is through assisted and natural regeneration. The success of this can be affected by many factors such as climatic change that drives the frequency of flowering and hence abundance of fruits and seeds. Most of the time, only small numbers of the trees flower sporadically in any population. In the case of Philippine teak, almost every aging individual (8-27 m high and up to 80cm in diameter) has been observed in mass flowering. This episode probably will not occur annually and therefore, efforts to preserve the young population of Philippine teak trees are recommended. Philippine teak has been highlighted since 1998 by the International Union for the Conservation of Nature (IUCN) for being vulnerable to extinction.

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## Local Management of Indigenous Mountain Rice and Fodder Tree: Short Notes on the Lowest Practice of Climate Change Mitigation

Leo D. Cueto and Anacleto M. Caringal

While many residents in the 'global village' are contemplating "inconvenient" warming and melting ice, there is, however, a need to think of "the small, the least and the lowest practices" by mountain people. In the mountainous coast of Lobo and San Juan, about 170 km south of Manila, Philippines, mountain farming is characterised by century-old kaingin (slash-and-burn); forest fragments are cleared to make way for growing food crops thus eliminating the natural island of trees as an important carbon sink.



Retreat from their kaingin (swidden) along the backdrop of forest green, mountain women with harvest accessory: takuyan (bamboo baskets) strap on the shoulder with a horizontal bamboo pole. The fruits of the mountain a year after slash-and-burn include the sweet berry (*Annona squamosa*), pigeon pea (*Cajanus cajan*), papaya (*Carica*), and indigenous variety of grain (*Oryza*). Following will replace the annuals with *Leucaena* fodder (shouldered by the boy - extreme left) for ruminant feeding. Photo: A. M. Caringal

But today, the traditional slashing-and-burning of carbon sinks is forgivable. Degraded and less productive mountain slopes have been converted to fodder tree plantation of nitrogen-fixing native ipil-ipil (*Leucaena philippinensis*) to sustain small-scale ruminant production. Plantations' canopies shade the barren slopes and provide a favorable micro-climatic condition most likely to encourage natural forests; rainfall interception and ground water recharge, thereby ensuring adequate supply during prolonged drought.

Leaving the phytomass after grain stripping or stocking the hay, is the earth-friendly feature of indigenous mountain rice cultivation. The unforgiving hay-burning after harvest is an extinct practice, lessening the potential contribution to carbon dioxide and nitrous oxide releases. Rice hays are either allowed to decompose for natural soil fertility restoration or fed to ruminants during extreme summer months when forage is scarce.

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## Changes of the Upper Tree Line in the Carpathian Mountains, Ukraine

Vladimir Kricsfalusy, Wojtek Mróz and Sergey Popov

Most of the world's mountain areas have a long history of human influence and development and in the Carpathian Mountains (Europe) there has been several thousand years of human impact. Human adaptation to environmental gradients and limitations (elevation zones, seasonal weather changes etc.) has created a vertical system of land use in mountain areas. Expansion of forests into previous agricultural areas after a long period of deforestation has been recorded in the many places around the world.

Several studies of the human impact on the structure and character of the tree line in the Carpathian Mountains were undertaken by Polish, Czech, Slovak and Hungarian naturalists in the beginning of the last century. After World War II, when most of the East Carpathians became a part of the USSR, Soviet and Ukrainian scientists carried out studies of natural and anthropogenic dynamics of vegetation.

The aim of this paper is to assess changes in forest cover over the past two centuries; to evaluate the transformation of the traditional system of land use and identify threats to the Carpathian mountain ecosystem.

### Study area

The East Carpathians are located in the central, most wooded part of the Carpathian Mountains. These studies were partly supported through the international project "Carpathian upper mountain forests: management and conservation for promotion of sustainable regional development", funded by the Carpathian Foundation in 2002.

The transformation of land use between 1,852 m and 2,000 m was assessed on the main mountain ridges (Marmorosh Mountains, Chornohora, Svydovets, Borzhava and Eastern Beskydy) of the East Carpathians that stretches from Romania in the south, to Poland in the north, covering approximately 3,000 km<sup>2</sup>.



Beech (*Fagus sylvatica*) tree line in the East Carpathians. Photo: V. Kricfalussy

The tree line changes in the East Carpathians within the Ukraine were evaluated using historical cartographic materials: cadastral Austro-Hungarian surveys, 1852-1864; Polish Military Institute topographic maps (WIG 1930's); Hungarian Military Department maps of the 1940's; Ukrainian topographic maps, 2000; economic maps edited by State Forestry Department in the Transcarpathian region of Ukraine, 1998; as well as modern GPS mapping and satellite data (Landsat ETM+ images).

## History of human impact

Human influence in the Carpathian Mountains dates back to the Mesolithic age. Long-term changes can be seen in the vegetation records which indicate that, even at this time, local people were harvesting some wood from the region. Waves of migrating and colonising people moved through the region at the beginning of the first millennium. From the 9th to 14th centuries, fire was used to clear areas of forest for settlements, greatly increasing human impact on the forests.

In the 16th century, Walachs migrated from the south throughout the East to West Carpathians, having a major impact on the culture of mountain settlements. Most of the land below 800m elevation was cleared of forest and a large part of the river watershed was transformed to agricultural land use. The belt above 800 m was used mainly for grazing. Several pastures were cleared within the forests up to the tree line (1,200-1,400 m), forming an intermediate pasture zone called poloniny (mountain meadows). Natural alpine meadows located above the tree line survived because the new pasture areas were created by clearing upper mountain spruce (*Picea abies*) and beech (*Fagus sylvatica*) forests, dwarf pine (*Pinus mugho*) and green alder (*Alnus viridis*) krummholz. These habitats were transformed into poloniny as well.

In the 19th century when the main railways were built across the Carpathian Mountains, forests were opened up to commercial exploitation. During this period, large areas of beech forests were clear-cut and reseeded with spruce or often with seed from non-native species, such as for example Douglas fir (*Pseudotsuga menziesii*). The resulting forests, particularly monodominant spruce stands were more vulnerable to natural hazards.

In the 20th century forest expansion began after new regulations of the Austro-Hungarian Empire, but this process was interrupted by the post-World War II political and economical changes,

particularly development of kolkhoz (collective farms in former socialist countries) agricultural land use. An intensive exploitation of mountain forests in the East Carpathians during the Soviet time has reduced the area of upper mountain forests and krummholz, increased erosion and exacerbated natural hazards (floods, mud flows etc.). In the 1950s, the proportion of forested land in the study area was the lowest since documentation began.

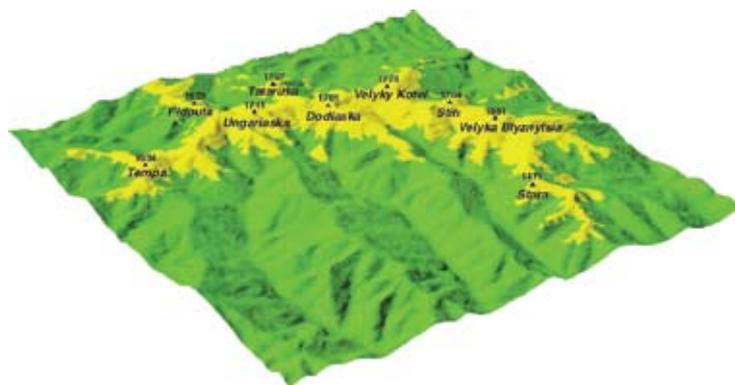
## Results

Based on the estimates of the upper forest boundary and environmental conditions in which it was formed, seven types of tree line in the East Carpathians were distinguished: thermal, wind, orographic, edaphic, avalanche, biotic and anthropogenic. Depending on the vertical distribution of the woody species, two variants of the tree line were recognised in the East Carpathians: the western beech and the eastern spruce tree lines. In the beech variant, the tree line is formed of beech (*F. sylvatica*), occasionally mixed with sycamore (*Acer pseudoplatanus*) and mountain ash (*Sorbus aucuparia* subsp. *glabrata*). In the spruce variant, the tree line is formed of spruce (*P. abies*), occasionally mixed with stone pine (*Pinus cembra*).

On the south-west slopes of the East Carpathians, in the Transcarpathian region, the average tree line of beech forests is 1190m in the western part and 1,280 m in the eastern part, sycamore forests - 1,160 m and 1,270 m respectively. The average tree line of spruce forests is 1,370 m and that of disjunctive phytocenoses is 1,470 m, while the upper limit of the solitary trees at least 8 m high is 1,485 m. On the north-east slopes of the East Carpathians, in the Lviv, Ivano-Frankivsk and Chernivtsi regions, the average upper spruce forest boundary is higher and reaches 1,470 m.

The gathered data enable us to analyse the historical changes of the upper tree line in all main mountain ridges of the East Carpathians. However, similar patterns of vegetation have been found in each of the ranges, and that allows us to analyse in the present paper the results just from the one of the studied mountain ridges, particularly one which is called Svydovets.

Svydovets is one of the biggest and most picturesque ranges of the East Carpathians. The present total area above the tree line covers approximately 633 km<sup>2</sup>; the mean altitude of the tree line of whole ridge is 1,338.2 m. A comparison of the tree line characteristics in 1,852 m and 2,000 m shows that the general area of polonyna decreased by 1,094.4 ha (14.7 %) and the altitude of the tree line became higher by 47.5 m (3.7 %) within the whole sample area.



The present tree line of the Svydovets range over a 3D digital elevation model (altitude 1,000 m above sea level)

Analysis of vegetation dynamics under human impact shows that the subalpine scrub communities almost completely disappeared, being transformed into polonina with mat-grass swards (*Nardus stricta*) or communities dominated by blueberry (*Vaccinium myrtillus*) with very low plant diversity. Only in some places where management was impeded by conditions such as steep slopes has the original vegetation survived.

Analysis of tree line distribution on cadastral surveys reveals that this situation has developed over a long time span and that human impact in this area was very intensive for at least the last two centuries. Aside from the direct effect of shepherding, another important factor in the case of Svydovets could also have been the burning of grass and krummholz which is nowadays observed in this area.

Although the shepherding pressure in Svydovets range decreased here in the 1990's (as across the whole Carpathian Mountains after the collapse of the socialist economic system), the vegetation dynamics is quite stable and it can be presumed that even without any management the situation would not change rapidly in coming years.

## Discussion

This study suggests that the tree line is in a certain dynamic equilibrium and depends both on relevant physical and geographical factors that stipulate it and anthropogenic influences. The tree line formed naturally and not affected by human impact is called the natural or potential forest boundary.

Climate change will likely cause the current tree line to advance upward. There is already a general trend toward increased growth in high altitude areas. Several studies show an increased growth of established trees and saplings above the tree line. This may be a general phenomenon in sub-Arctic and Arctic sites, as a widespread increase in shrub abundance has been seen in Alaska.

It has been determined that apart from natural factors (windthrow from storms, avalanches, soil and thermal gradients), the most important factor for lowering of the tree line is anthropogenic: grazing, cutting trees for the building of summer houses, stables, fences, fuel etc. In place of primary communities there appeared secondary ones which occupy over half of the whole sub-alpine zone. Secondary communities are formed according to the same successional scheme. Spruce and beech forests, dwarf pine and green alder krummholz, thinned out as a result of cutting, trampling and less frequent burning, are changed first by annual grasses, then by various perennial grasses and finally, by dense turf communities which tolerate grazing and trampling better.

In conclusion, we found that the expansion of forests, related changes in land use systems and biodiversity conservation may apply not only to alpine areas (vertical systems) but to sub-arctic ones (horizontal systems) as well. The results derived from this study recommend extending research to other regions with the methodology presented above. Using the Carpathian tree line ecosystem responses to past human impact and climate change as a case study, we can provide an insight into possible scenarios of response to future change and can elucidate factors that may influence the overall predictability of such responses.

The necessity of the tree line restoration requires precise data for its right configuration. This would help solve the problem relatively inexpensively, promoting development of



Spruce (*Picea abies*) tree line in the East Carpathians. Photo: V. Kricsfalusy

the forest and pasture economy and integrating it with nature protection objectives. Restoration of a traditional forest and pasture economy is one of the methods of supplying sustainable development of the mountain regions.

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## Climate Change: Opportunity or Threat in the Central Andean Region of Peru

Luis Suarez



Glaciers in the Junin region, Peru. Photo: Luis Suarez

The various documents prepared by the Intergovernmental Panel of Climatic Changes (IPCC) indicates that for the coming years there will be an increase in temperature of some degrees, a rise between 1.8 to 4° C, as a best estimate. This rise could cause an increase in different climatic phenomenon that would cause severe loss of human materials around the world. Developing countries are more vulnerable. Nevertheless, it is also possible that this warming brings some important benefits in some locations of the planet. This article considers these aspects within the context of the social, economic and environmental reality of the department of Junin, in the central Andean region of Peru. It also emphasises the key role played by the actual optimal management of natural resources in some cities located in the mountains.

### Reduction of child mortality

The various statistics of morbidity and mortality, especially of children are associated with the cold season in the region, from May to August. It is enough to see the statistics of the terrible year of 2007, with nearly 100 dead children and thousands affected by the cold spell covering all the Andean region of Peru. The same is registered in previous years where it is seen that the greatest cause of disease is related to respiratory system being children the most vulnerable. The Regional Health Direction of Junin indicated that during 2005 respiratory diseases occupied first place with 41.4 % of cases related to children of zero to nine years. It is not a recent invent, it is also mentioned in the last IPCC report.

In the Andean region every year there will be children dying because of respiratory diseases like pneumonia, in spite of the "great knowledge" that every year we have very low temperatures. The newspapers bring the bad news of the death of children, but this does not have anything to do with any climate change, only with a lack of resources in the health sector. The death of a single child as a consequence of the cold is a clear sign of failure of any health campaign. Unfortunately, this is something that happens every year.

### Reduction of frost

One of the greatest threats identified by farmers of the region is frost. It is a serious threat considering that it can impact hundreds of hectares, also affecting many types of crops. This year was especially disastrous causing about USD 4.5 million in the agricultural sector in the provinces of Junin, according to the Agrarian Information Bureau. Nearly 6.487 ha of different crops were affected. The anomaly was that this frost appeared outside the cold season, in February, when the plants were still growing. The aid offered by the Government to those affected by this frost has not arrived yet.

Although, the IPCC has indicated that some extreme events will be increased, is not possible to maintain in a warmer environment the increase of seasons of lower temperatures and/or frosts. A recent work presented in a conference on climate in Huancayo by Lourdes Menis of the National Meteorological and Hydrological Service of Peru SENAMHI, showed that there has been a reduction of frosts periods in the Andean region of Peru. Also, in a recent study using the data of the Observatory of Huancayo, the researchers of the Geophysical Institute of Peru showed that there has been an increase of 1°C in the last 50 years.

### Reduction of water resources

Important data sets indicate that the disappearance of tropical glaciers, including the Peruvian glaciers, is very likely, in the next 50 years because of the projected increase in temperature. Water resource is a key element for the Valley of the Mantaro that is at the heart of Junin, where agriculture is the most important activity, and also is essential for human subsistence and energy production, about 40 % of national hydropower production. This accelerated melting of water reserves contained in glaciers will cause future conflicts of interest by its use.

Nevertheless, at the moment, problems associated with water shortages already exist for agricultural irrigation as well as for human consumption. It is considered to be of critical importance to improve water management from now onwards. Even now when there must have been an abundance of water due to the accelerated rate of melting, there exists a problem of water availability, with 35 % of the population in the region without access to drinking water. Water management needs to be harmonised with the use of the reserves of the lagoons that are available in the region. The projects Mark I, II, III and IV, literally, have taken water reserves in the mountains from Junin to Lima, the capital of Peru. The Andean lagoons of Junin cover more than 100 km<sup>2</sup> and contain thousands of cubic meters of water, but due to bad management this water is taken to another region, to Lima, leaving us without future reserves.

Rio Shullcas that is provided by water directly from the main glacier of the region, Huaytapallana, is a river that is contaminated and useless for consumption by the time it arrives at the city of Huancayo. This is also happening to the most important river of the region, the Mantaro, along its 724 km, severely polluted by wastewaters from urban settlements, mining and metallurgic companies. This means that its value for

agriculture is almost nil. It is clear, then, that these conditions are more important to modulate the actual and future use of the water resource in the region that any signal related to climate change or changes in the neighbouring forests of the Amazon. These are problems that have clearer solutions that are easier to solve than the complex terrestrial climate.

It is true that climatic change is an important subject at a global level, but it is important to put it in the right context within local mountain ecosystems. Also, from this preliminary evaluation, it is important that policies should be oriented by an efficient coordination among the diverse statements of the local government in order to be able to manage the threats and opportunities satisfactorily. This is a crucial aspect, because there are some plans that are under development for directing the economic and human resources. For example in the Andean region of Junin, the Strategic Plan of Regional Development for Junin 2008-2015 is available. In this document, regional government emphasises the importance of the climatic change stating "... it is a reality and it will affect with greater intensity the department (of Junin). In this sense it is necessary to get prepared to confront the possible natural disasters that will occur like the increase of rains in the jungle, the frosts and drought in the mountain, among others." However, this topic is "so important" that in the investment schedule, projects related to adaptation to climate change are budgeted just for the years 2013 and 2014.

Thus, these are some considerations to take into account to confront adequately both climate change and natural resource management of our Andean regions.

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## Experience of a Herder's Life in Western Bhutan

Nakul Chettri



Fifteen-man Bja (yak hair tent) with a solar panel, Bhutan. Photo: Nakul Chettri

Pastoralism is an age-old livelihood option for millions of people of different castes and ethnic groups and makes a significant contribution to the economy of the Hindu Kush Himalayas (HKH), both in terms of providing employment and income opportunities and in supplying nutrition to the rural poor. Bakrawals, Gujjars, Gaddis, Kanets, Kaulis and Kinnauras of the north Indian Himalayas, Bhotias and Sherpas of the Khumbu valley of Nepal, Kirats of eastern Nepal, Lachungpas and Lachenpas of Sikkim, Changpas of Ladakh and Brokpas of Bhutan are some of the well known pastoral communities of the Himalayas.

Pastoralism in the HKH is based on transhumant practices and involves cyclical movements from the lowlands to the highlands to take advantage of seasonally available pastures at different elevations. During the summer when the snow melts in the higher alpine regions, Himalayan pastoralists move up to these areas to graze their animals. After the monsoon they move down



*Bja are being replaced by cheap and unsustainable polythene tents, Bhutan. Photo: Nakul Chettri*

to occupy the low altitude pastures for feeding their animals. Movements of people and their livestock proceed between previously embarked sites, which become more or less regular seasonal encampments or bases. However, the livelihoods of these pastoralists are at stake due to various external forces starting from modernisation to policy imperatives. The prevailing climate is bringing new challenges to these vulnerable communities. The implications for pastoral livelihoods are yet to be fully understood and indeed two quite different opinions seem to prevail with respect to climate change. Some see pastoral groups as the 'canaries in the coalmine' of ongoing processes, as rangelands will tend to become drier and existing water shortages will worsen, thus affecting the overall sustainability of their livelihoods. Others see pastoralists as the most capable to adapt to climate change, since pastoral livelihoods are shaped to deal with scarce and variable natural resources and to tackle difficult and uncertain agro-ecological conditions, and climate change could conceivably lead to the extension of territories where pastoralism could show comparative advantages.

It is important to know 'why people do what they do' especially in traditional societies which have remained relatively unchanged by the forces of modern technological advancement. In the high altitude areas of Bhutan at elevations higher than 3,000 m, yak production has been and continues to be the main source of livelihood for people inhabiting this rugged landscape who are known as Brokpas in central and eastern Bhutan, Bjops in Western Bhutan, Lakhaps in the West-Central region and Dakpas in the remote gewogs of Merak and Sakteng under Trashigang Dzongkhag. All these names, in one way or other mean 'pastoralists' and underscore the dependence of the people on the pastures (known as Tsadrok and Tsabrok in eastern and central Bhutan or Tsamjo in western Bhutan) and the mountains (La). Yak rearing is practiced throughout the northern belt of the country extending from Haa in the west to Trashigang in the east and the production systems vary considerably from place to place. Nevertheless, there is no denying that the yak is the lifeline of all these communities and is aptly referred to as the 'camel of the snows'. It is a multi-purpose animal providing milk, meat, draught and manure. It also adds to the aesthetic value of the Himalayas. Without it, one cannot imagine how humans could survive in this beautiful but hostile region.

I had the opportunity to come across the lifestyle of a nomadic group of people when I trekked to Zumolari base-camp in western Bhutan during the monsoon in 2006. I came across a number of tents made up of yak hair called Bja, widely known to the outer world as the One Hundred Peg Tent. They are widely used by a group of nomadic people called Bjobs who use these

tents as their shelter for at least six months a year. They are made up purely of the black hair of matured yaks and weigh about 30-53 kg depending on the size of the tent. It was learnt that after the collection of sufficient yak hair, the Bjobs consult a tsib (astrologer) to fix a date on which the weaving of the tent should start. This is practiced to have a long lasting Bja and there is a belief that even a single white hair will shorten the lifespan of the Bja. Once the date is fixed, the zow (a special skilled weaver) with the help of three to four assistant weavers takes on the task of designing and preparing the tent. It may take 6-15 days to complete the tent depending on the size. The zow normally designs the tent in such a way that it can be made in two pieces, so that it is easier for the Bjobs to carry on two horses when transporting it from one pasture to the other. A good and strong Bja may last 20-25 years in spite of its use in a harsh climate.

What impressed me is its utility in terms of sustainability and adaptation to climate change. The tents withstand heavy snowfall, rainfall and wind. However, they are comfortable enough to cope with these extreme climates as they do not allow leakages nor are damaged by the wind. This was reflected by architecture of the tent as there are 100 pegs to hold the tent upright and the angle maintained in the tent does not allow leakages. Social-harmony was evident among these herders as they help each other to erect the tent, which normally needs four strong hands. Livestock is looked after by a hired herder or member of the family owning the herd, sometimes living together in one Bja. Thus, they show an intact social structure and mechanisms for mutual sharing of resources and their livestock which also represents an encashable asset. It is quite evident from the lifestyle of these people that they can withstand the extreme cold and harsh climate in alpine pastures and the trans-Himalayan areas. These pastoralists have shown themselves very resilient and adaptive to such extreme climate.

Though extensive pastoral production occurs throughout the Himalayas, typically in areas where soil, rainfall and temperature conditions limit the range of options for sustainable land use; agro-ecological conditions and the physical characteristics of pasture resources are critical in shaping the socio-economic livelihood patterns of pastoral communities. This hinges upon strategies that continuously adapt to a limited, highly variable and unpredictable resource endowment. Pastoral adaptation faces a myriad of challenges, of which climatic change is one. Indeed, the challenge of climate change seems insignificant to many pastoralists who are faced with extreme political, social and economic marginalisation. Pastoralism is particularly sensitive to population growth because, unlike in cultivated areas, the technical possibilities for raising productivity in the rangelands are limited and tend to be more resource-degrading.

So, it is a complex form of natural resource management which requires maintaining an ecological balance between pastures, livestock and people and it is an adaptive strategy to a stressful environment. Though pastoral systems are globally important as they support food, economic and diverse ecological services to some of the world's poorest countries, the vulnerability that is associated with climate change in some pastoral environments has its roots in the limitations of tried and tested pastoral coping strategies, including the ability to move through different territories, to access critical livelihood resources, to trade across borders, to benefit from appropriate investments and to participate in relevant policy decision-making. As is so often the case in developing regions, the main concern for pastoralists is the accessibility, rather than the availability or variability of resources. Although the odds seem stacked against them, as modernisation and easy access to modern materials such

as polythene as an alternative to yak-hair for tents and the decline of the zow and their practices, there is some hope that the emphasis on the conservation on biodiversity from global communities is on the rise. Thus the pastoralist might be able to benefit from recognising their role in conserving the genetic diversity of livestock, valuable indigenous breeds and indigenous knowledge about coping mechanisms for environmental stresses like climate change.

The general belief that traditional pastoral practices need to be improved has largely shaped pasture development policy throughout the world. However, in the Himalayan countries, they have generally ignored the role of livestock in development and failed to appreciate the efficacy of traditional pastoral systems. There is an urgent need to develop policies and programmes that are sensitively attuned to and supportive of local people who are the prime actors at the interface of the man-nature relationship. Sustainable innovations for economic enhancement of people or ecological improvement of the environment in which they live can only be introduced if there is a high degree of relevance to prevailing local cultural and production practices and traditions.

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## Food Security Amidst Climate Change in Nepal

Dinanath Bhandari



Chitwan - terraces being washed away, Nepal. Photo: Practical Action Nepal

Climate change hits hardest on food security in Nepal. Our food production being based on the rain, depends on the weather pattern, so even small and short periods of weather extremities badly affect production and supply. Lesser availability of surface and sub-surface water for irrigation adversely affects crop production and this is combined with flood damages to arable lands in summer.

Vulnerability of the infrastructure affect food supply and access particularly in the mountain regions where people are already vulnerable to the increase in price hikes and food shortages. Coping capacity at the local and national level is very low. People lack flexible strategies of livelihood options as alternatives for household income. Field level studies and preparedness to curb adverse impacts with proper adaptation measures are urgent for different sectors including agriculture.

### Food and food security in Nepal

The number of food-insecure population increased from 3.5 million (19 % of the population) to 5 million (23 % of the population) between 1995 and 2002 (FAO, 2003: cited in FAO, 2004). Incompetent production is one major factor, besides access and affordability, where impacts of climate change have embedded to catalyse the deteriorating factors to food production and access to it.

Heavy dependence on agriculture makes Nepal's economy very sensitive to climate variability (World Bank, 2002). Over 40 % of the GDP is dependent on agriculture which came down from 52 % in 1990 (MOAC, 2007). Forests provide the highest input to agriculture and is on the verge of change in composition. Nepalese agriculture is characterised by low-productivity subsistence production and has been in relative decline since the 1980s. Per capita cereal grain availability has fallen from 198 kg in 1991 to an estimated 186 kg in 1997 (UN, 1999).



*Flooding at Banke, Nepal. Photo: Practical Action Nepal*

The recent food production scenario has changed remarkably with an overall reduction of 3.35 % on cereals and other crops as compared with the 2001 baseline (MOAC, 2007). The rate of decrease is increasing. Rice, which is the main source of food in Nepal and has a 20.75 % contribution to the GDP, has decreased by 12.55 %. There is mixed experience from other crops such as vegetables which have a 9.71 % contribution to the GDP which has increased by 6.67 %. This reveals the food security situation in the country which shows a very disappointing scenario - where population increases by 2.25 % annually; food production decreases at a greater rate.

The rate of global temperature change is outside of any change experienced in the last 10,000 years and most likely much longer (Coach, 2007). This has caused increase in weather extremities, erratic pattern of rainfall, polar ice melting and faster glacier retreat than ever before. This is not just the matter of physical change and statistics; it has huge impact on both the aquatic and terrestrial ecosystems. Food security is the most important issue amidst climate change since agricultural production is an important player in both the biophysical and socioeconomic worlds; also an important agent of environmental change.

### **Potential impacts of climate change on food security**

As temperature increases, sea level rises and the nature of precipitation changes and undoubtedly crops are affected most. Food is derived from crops or the animals that feed on crops. Agriculture is the main base of food security in Nepal. Besides, it provides employment, income and economic base (Gill, 2003). Climate change affects agriculture through changes in atmospheric temperature, precipitation, climate related risks and its impact on crop yields, forests, water resources, species and natural ecosystems.

### **Impacts of rising temperature on food security**

Global food production potential is likely to increase with an increase in global average temperature up to about 3°C (IPCC, 2007a). But the temperature is not alone as a factor of production. It is uncertain that what could happen when there is not sufficient water to maintain increased evapo-transpiration, extreme weather events like hail and storms, cold and heat waves which are likely to increase due to the increasing temperature. And there is another issue whether this benefit of warming can reach poor and subsistence farmers in the least developed

countries to feed the growing population. Already there are not many hopeful messages to farmers who depend on rainfall which is already being unfriendly to them.

If increases in temperature exceed 1.5-2.5°C which is likely, then around 20-30% of plant and animal species are likely to be at increased risk of extinction (IPCC, 2007b). As the base of indigenous varieties has been deteriorating with genetically modified seeds, climate change will enhance the rate of growth of indigenous species and varieties which have a better capacity to sustain the adverse environmental consequences in the longer term. It is obvious that smallholder and subsistence farmers will suffer complex, localised impacts of climate change combined with the globalisation of market opportunities.

### **Impact of change in precipitation**

Global analyses with the GS Model concludes that erratic patterns of precipitation have an adverse impact on production (Sacks, L., and C. Rosenzweig, 2007; IPCC 2007a; IPCC 2007b). Precipitation in Nepal has noticeably fluctuated for the past 30 years or so (Shrestha et al, 2000). Based on the experiences shared by the farmers, they have noticed that it does not rain as usual but when comes it comes, it rains too much and creates floods.

This implies that there is greater rainfall in fewer rain storms. The crop yields have a strong association with the amount of rain received at the right time. The reduction of rice production in the past years can be closely linked to the abnormal rainfall received in those years. Although there are other factors to take into account, climate impacts have definitely a crucial role in this decline despite the efforts of farmers and service providers in introducing better quality seeds, varieties, fertilisers and care.

### **Climate related risks and extreme weather events**

Glacier retreat and glacier lake outburst flood (GLOF) are important and widely discussed issues as the potential risks. Many studies have been carried out on glaciers, their retreat and the formation of glacial lakes vulnerable to outburst. With the melting of glaciers, water availability will rise and then decrease sharply; it has an effect on irrigation, power supply and aquatic ecosystems (IPCC, 2007b).

Studies (WECS, 1993; Kadota et al, 1997; Kadota et al, 2000; Mool et al, 2001 cited in Bajracharya et al, 2007; Fujita et al. 2001; Yamada et. al. 1992) on glaciers in Nepal have shown that they are retreating and the number and size of glacier lakes are increasing along with the increase in temperature. Nepal has already experienced a number of disasters from such GLOFs with a lot of loss, such as Dig Cho GLOF in 1985 (Bajracharya et al, 2007).

Similarly severity of extreme climate events together with increased risk of fire, pests, and disease outbreak have significant consequences on food and forestry production and food insecurity (UNFCCC, 2007). Due to drought and extreme hot weather, forest fire has become an annual phenomenon. Flood damage, hail and wind storms alongside sudden droughts within the monsoon period have increased in Nepal. Other factors such as a fragile geology and faulty agriculture practices rather than climate change might have a greater impact but climate change has created an environment to lead to greater adverse impacts.

### **Coping capacity**

Nepal is among the poorest countries in the world. The level of

absolute poverty is among the highest in Asia. The lack of options and flexibility in livelihood strategies constrains people's ability to make positive livelihood choices and reduces their ability to withstand or adapt to shocks and stresses such as droughts, floods and other adversities.

As climate change is of a global scope, determined by international political and socioeconomic agendas, it has become more complicated and interlinked largely with other disciplines and issues. Locally available practical solutions are rare. Site specific studies and strategies are necessary for particular sectors and communities. Enabling communities to better understand the impacts of climate change and encouraging them to find innovative solutions to reduce vulnerability and develop adaptive capacities is important for Nepal.

## Conclusion

Climate change has an adverse impact on overall food security. Particularly poor and marginalised people are more vulnerable due to their low coping capacity. Information on specific impacts on different sectors and ecological regions is still limited. Field based studies are important and urgent for designing appropriate coping mechanisms. Strategies and investments in research and piloting adaptation approaches would benefit people to have some options on food security amidst climate change.

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### A Coping Strategy to the Impacts of Climate Change in Mountain Regions of Nepal

*Gehendra Bahadur Gurung*

Ten kilometers north of Narayanghat in the Chitwan district of Nepal, on Narayanghat - Mugling highway, there is a stream called Jugedi Khola. Jugedi Khola originates from the lower Mahabharata with a watershed area of 12.2 km<sup>2</sup>. Geologically the lower Mahabharata region is fragile and the hill slopes are steep whereas the valley bottoms are good for agriculture. The Jugedi watershed provides home to 190 households of 12 different ethnic communities spreading over 10 settlements.

The main livelihood option of the people here is subsistence agriculture. Because of the sub-tropical climate, local people can grow crops throughout the year. However agriculture is nature based - the climate and the weather determine the success and failure of the crops. The major crops grown are rice, maize, finger millet, beans and pulses in summer, and wheat and mustard in winter. The villagers also grow seasonal vegetables. Goat, cattle and buffaloes are the major livestock of the area. The average landholding is 0.43 ha by a family of six.

Practical Action Nepal has implemented a project on "Increasing the Resilience of Poor Communities to Cope with Impacts of Climate Change" in the Jugedi watershed. Impacts of climate change are being perceived by the communities. One of the perceptions is the unpredictability of rains, including monsoon. In the past, people could predict the rain, based on which they prepared the fields, nurseries and transplanted crops. But in



Participatory action planning meeting, Nepal. Photo: Practical Action Nepal

recent years the rain does not match with their predictions. The main rice transplanting month, July, is not getting sufficient rain. The rain occurs late when the seedlings are too old. Late transplanting of old seedlings reduces the yield and affects the following winter crops. As the communities relied on seasonal rain for rice transplanting, they were not prepared for planting alternative crops like finger millet. So some farmers leave the lands fallow for continuous years.

The local people have also observed that there are extended monsoon rains which are not good for the crops. The rice crop requires minimal irrigation at maturation stage. But the continuous rain delays the maturation ultimately affecting the production and the succeeding winter crops.

The rains in other seasons, winter and spring, are also not sufficient for generating enough soil moisture. Spring, the maize growing season, (March - May) has become hot and dry. Farmers have observed that hot and dry days at the cob development stage affects the pollination, resulting in poor maize production. At the early stage, it results in wilting of young plants.

The nature of the rainfall has also become intense, causing soil erosion on slash and burn cultivation fields, creating gullies and landslides on the slopes, and resulting in flashfloods in the valley bottoms. All types of agricultural lands, on the slopes and in the valleys, are affected pushing the people towards landlessness. The landslides and flashfloods not only destroy the lands, but also destroy local infrastructures like irrigation canals, foot-trails and houses.

Occurrence of fog in winter in the plains and valleys was common. But now people experience it at higher altitudes above its usual upper limits. Such fog is affecting the production of winter crops such as mustard. In the case of livestock, the liver-fluke was common in the lowlands, but now it is affecting buffaloes at higher elevations. As a result many households have abandoned keeping buffaloes.

#### The problem

All the problems highlighted above were not new to local people. They have encountered these problems before but have managed and coped with them. What is new, is that these problems are increasing and people face difficulties in managing and coping with them. During the interaction with the community, they were unaware of the notion of "climate change" - the cause behind the unpredictability of rainfall and extreme, hot and dry days.

People are responding to the impacts of climate change, without taking account of climate change as the cause of their problems, which makes the existing technologies, skills and resources inadequate to address the growing problems. The existing skills and technologies were developed under climatic conditions that prevailed for long time until the recent human induced climate changes have started to occur.

At the participatory planning meeting held with the communities in order to help them strengthen their capacity, they identified such activities which help re-enforce their ongoing activities. All of these activities were also not new, including such things as protection of lands from landslides, floods and soil erosion; rebuilding and developing old or new irrigation canals and infrastructure, suitable crop species and varieties under the changed rainfall conditions, protecting the forest and planting trees on degraded lands, training on alternative income generation skills etc.

## Strategies to cope and adapt to impacts of climate change

Based on community participation, a whole range of activities was developed which finally looked like an Integrated Conservation and Development Program. The major programs comprised the following:

1. Institutional development
2. Disaster risk reduction
3. Alternative income generation
4. Alternative agriculture
5. Natural resources management
6. Infrastructure rehabilitation
7. Awareness on climate change

The community realised the need of an organisation that represents all communities within the watershed. They formed a Community Based Organisation (CBO) and registered at the office of the district authority. Now the CBO identifies problems and actions through consensus and mobilises the members in implementing the actions that help strengthen their capacity to cope with the impacts of climate change. The CBO coordinates with the village development committee (VDC), district development committee (DDC) and other government and non-government institutions in the district to get technical, financial and institutional support.

Disasters due to landslides and flashfloods because of intensive rainfall are also major problems. The communities identified soil conservation, control of gully formation and landslides, and putting gabion wire check-dams for protecting lands from flashflood as major activities.

The climate induced disasters have led to some of the households being deserted, whereas many have lost their lands and many have been left with degraded land. This has forced people to look for alternative income sources. Therefore one of their identified needs was to create alternative income sources, but priority was given to farm based activities such as vegetable farming, goat keeping and dairy. These activities were built on their farming knowledge which helped make more productive use of the limited land resource. Some farmers having only 2-3 katthas (1 kattha = 333 m<sup>2</sup>.) of land were able to increase production more than ten folds in terms of financial value.

Slash and burn and shifting cultivation on the slopes in the Jugedi watershed area are traditional practices. But these practices are not compatible with the changed rain pattern now. The intensive rain in the monsoon erodes the slopes and the dry

and hot season reduce the soil moisture significantly. However, the people have to cultivate these slopes because these are the only lands available for some households. The local people were trained and supported on Slope Agriculture Land Technique (SALT) which helps to increase the land productivity and reduce erosion and landslides.

Some farmers changed the cropping system from rice - wheat - maize to fruits. They have found that annual crops were very sensitive to climate change compared to perennial crops. When rainfall deviates by even some days, rice, maize and wheat are significantly affected. But perennial crops like banana are impacted less under such circumstances. The farmers who decided to change the crops were supported through training and inputs. (because they were supported for banana suckers and fruit seedlings as well).

The local people also decided to effectively manage their forest resources. In their understanding, forest degradation might impact local climate. Also they were aware that protection of the forest will help protect the land from erosion, landslides and flashfloods. They registered two forest users' groups at the District Forest Office for legal recognition. They decided to have a multipurpose forest nursery and plant trees on naked slopes. The priority for plantation was in up-stream micro-catchments and gullies where erosion and landslides start. The species chosen are multipurpose species.

Rehabilitation of irrigation canals was another priority activity. The existing canals were destroyed by frequent landslides and floods and the requirement for them was increasingly high because of a lack of rain at the time of need. So the communities implemented rehabilitation and repairs of irrigation canals and foot trails at strategic points.

Awareness raising activities included home visits and educational visits for village people and school children, including slide talks at schools on climate change and its impacts. Slide talks were also organised for district level stakeholders to raise their awareness on climate change, its impacts and to help (the sentence also intends to influence them) influence them to mainstream this issue into their regular actions.



House damaged by a flashflood, Nepal. Photo: Practical Action Nepal

### Conclusion

Climate change is affecting poor communities. But impacts are not completely new. The impact mainly intensifies and increases the frequency of existing problems, taking them outside the coping capacity of communities within the existing system. The approach to strengthen the coping capacity of the communities does not require completely new actions or programs, but it requires an integrated approach as the impacts are multifaceted. The experience of Practical Action Nepal shows that an Integrated Conservation and Development Program can be one approach to help increase the resilience of communities.

It should be community-based as the impacts are localised and the best solutions depend on the local vulnerability context to climate change. The communities and the local stakeholders require awareness on climate change and its impacts to help them mainstream this issue into their regular plans and programs.

Currently development of a national policy on climate change is in progress in Nepal. A policy is urgently needed which helps recognise this issue at a national level and to incorporate it into an overall national development process.

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Practical Action is a UK-based development organisation established in 1969. Its vision is "a world free of poverty and injustice". Practical Action is working in Asia, Africa and Latin America. In Nepal, this organisation started working in 1979 on micro-hydro electricity and established the country office in 1998. Currently Practical Action Nepal is working on seven broad program areas in Nepal including food security, disaster risk reduction, adaptation to climate change, markets and livelihoods, renewable energy, clean air and improving access for the poor. It is focusing its activities in 17 districts from Mid, Western, Mid-western and Far-western development regions of the country.

### Climate Change in the Western Ghat Mountains: Impact and Adaptation

S P Anandan



Central Station, Kurangani Hills, India. Photo: P. S. Bose

Conservation International has declared the Western Ghats Mountains as one of the 34 global biodiversity hotspots in the world. The Western Ghats of southwestern India and the highlands of southwestern Sri Lanka are strikingly similar in their geology, climate and evolutionary history. Together, they form one of the most densely populated of the 34 global biodiversity hotspots. This hotspot is extraordinarily rich in species, especially plants, found nowhere else. However, its forests face tremendous population pressure and have been dramatically impacted by demands for timber and agricultural land.

The Sierra Club is promoting and helping Indian environmental groups develop effective conservation strategies for the hills of the Western Ghats. The United Nations Environmental Programme also considers closed-forest preservation 'critical' in the area and all of India. Today, the challenge of mountain biodiversity entails not only documentation of information but its management, application and communication so that a clear picture will be available on the impact of climate change in the Western Ghats. The quality of research on mountain biodiversity and ecosystems of the Western Ghats depends on the individuals who perform it. So far, no indigenous scientific community has been involved in conserving various hills and mountains of these mountains. Green laws of conservation have never reached indigenous communities. The key to sustainable ecological development of the Western Ghats Mountains is to involve all indigenous communities dwelling in the mountains and hills. In fact, tribal community members can show our conservationists how human beings and the environment can live symbiotically since they have inherited conservation practices from their ancestors who were the guardians of mountains. Our Foundation, the Foundation for Research and Sustainable Development (FRSD) wishes to remind policy makers on the necessity to preserve various isolated hills of the Western Ghats from the impact of climate change.

Our Foundation and GREEN, an NGO in the Kurangani hills are active in highlighting the impact of climate changes in the Western Ghats Mountain range in the Theni District, Tamil Nadu, India. Our focus areas are the Kurangani hills of the Bodinayakanur block and Suruli hills of the Cumbum valley in the Western Ghats. Researchers say that "The projections of impacts using the outputs of the current climate models and vegetation response models are characterised by high uncertainty. There is therefore a need to improve the reliability of climate projections at a regional level and use dynamic vegetation models."

There are 27 forest areas in the Theni district constituting a total area of 79,581.24 ha (795.81 km<sup>2</sup>). 19 areas fall under the Reserve Forest category with 25,543.75 ha (255.44 km<sup>2</sup>), eight under the Reserve Land category with 54,037.49 ha (540.37 km<sup>2</sup>) and there is no Unclassified Forest type in this district. In the district, the total area of forest under green cover classification is 80,686 ha. Dense forest and sparse forest are 29,281 and 2,243 ha respectively. There has been no conservation of biological resources in the district. The information from a wild life census in the Theni district is yet to be made available (Government of Tamilnadu - Theni District website).

The forests of the Western Ghats are some of the best representatives of non-equatorial tropical evergreen forests in the world. The Western Ghats have evolved into one of the richest centres of endemism owing to their isolation from other moist areas. The hills of the Western Ghats are embedded in a landscape that has much drier climatic conditions (Ramesh et al. 1997). South of the Kodagu district in Karnataka, the elevation increases. The topography creates several enclaves that have acted as refuges for species over the years as surrounding areas have steadily grown drier. Variation in the degree of endemism in the Western Ghats depends on both the latitudinal length of dry season gradient as well as the temperature/elevation gradient, with a greater number of endemics found in areas with a short dry season and higher altitudes (Ramesh et al. 1997). The tall Western Ghats mountain range intercepts the moisture from the southwest monsoon, so that the eastern slopes and the Deccan Plateau receive relatively little rainfall: from 900 to 1,500 mm. The undulating hillsides have very shallow soils. (Ecosystem profile-CEPF)

The angiosperm diversity of India includes 17,672 species. With 5,640 species, Tamil Nadu ranks first among all the states in the country. This includes 533 endemic species, 230 red-listed species, 1,559 species of medicinal plants and 260 species of wild relatives of cultivated plants. The gymnosperm diversity of the country is 64 species of which Tamil Nadu has four species of indigenous gymnosperms and about 60 introduced species. The pteridophytes diversity of India includes 1,022 species of which Tamil Nadu has about 184 species. Tamil Nadu wild plant diversity also includes vast number of bryophytes, lichens, fungi, algae and bacteria. The faunal diversity of Tamil Nadu includes 165 species of fresh water fish, 76 species of amphibians, 177 species of reptiles, 454 species of birds and 187 species of mammals. According to the CAMP reports, the red-listed species include 126 species of fish, 56 species of amphibians, 77 species of reptiles, 32 species of birds and 40 species of mammals. The endemic fauna includes 36 species of amphibians, 63 species of reptiles, 17 species of birds and 24 species of mammals. Schedule I animals include 22 species of mammals, 42 species of birds and nine species of reptiles. Schedule II animals include 13 species of mammals. Schedule III animals include five species of mammals. Schedule IV animals include five species of mammals, 367 species of birds, 109 species of reptiles and 23 species of amphibians. Schedule V animals include 13 species of mammals and one species of birds. (Tamilnadu Forest Department)



Tribal settlements in Kurangani Hills, India (Mudhuvaakkudi, Muttam hamlets). Photo: P. S. Bose

The Suruli Hills and Kurangani Hills of the Theni District are popular for resounding cascades, water falls, silver-lined clouds, sacred groves and temples of antiquity and above all, wonderful floral and faunal diversity. The Kurangani hills lying beneath the Munnar hills in Kerala are popular for cardamom, coffee and tea estates. So far, no conservation efforts have been taken to regenerate the hilly terrain. GREEN, Chinnamanur, a non-governmental organisation has been implementing an important project titled "Endogenous Spices Tourism Development" supported by the Ministry of Tourism, Government of India and the UNDP. GREEN is working to attract tourists to this ecologically important hilly terrain. The region is home for rare flora and fauna. Tribal community members like Mudhuvas and Pulayars are native to this mountain region and have been dwelling in isolated hamlets under miserable conditions. The region was once under the control of Tata Tea Estates. Three hundred houses were built for the tea estate workers. The estate workers are still found in the region largely unemployed. Initiatives are yet to be taken for adapting to changes in the mountain environment caused by climate change or adaptive strategies to cope with impacts of climate change in this region.

'Kurangani' literally means "a procession of monkeys" as there were thousands of monkeys in Kurangani in the Theni District. Today, we cannot spot even a single monkey in Kurangani because of the changes in climate, human pressure and habitat destruction for commercial gains. Kolukkumalai tea is very famous since the tea estate is near Top Station near Munnar and the tea is popular for its natural taste. Cardamom and Kolukkumalai tea are exported for the wonderful aroma since they are still grown in Kurangani, in the Bodi Mettu region. Yet the aroma and flavour of the spices available today in Kurangani are not the same as they were fifty years ago. This is mainly because of the ecological disturbance in the region and that no conservation measures have been taken to restore the glory of Kurangani hills. We shall restore the lost glory through our newly formed "Sustainable Mountain Development Forum", a network of civil society members opposing environmentally destructive practices in the Western Ghats.

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Foundation for Research and Sustainable Development (FRSD) is an NGO and has been engaged primarily in preservation of nature and natural resources in the Western Ghats range of mountains in Tamil Nadu. We have been addressing the threats to biological diversity in Western Ghats chain of mountains and the hills connected to the mountainous terrain in southern Tamilnadu, India. Members can read our featured article in Mountain Forum Bulletin January 2007 issue under Members Initiative to know about our work in the Western Ghats mountains in Tamilnadu, India.

## Potential Impacts of Climate Change in the Uttarakhand Himalayas

*Prakash Rao, G.Areendran and Rajneesh Sareen*

Global climate change has come to be seen as a major issue confronting the lives of millions of people around the world. Temperature data available since 1000 A.D. indicates that the 20th century was unusually warm and the decade of the 1990s was the hottest on record with six of the warmest years occurring in this last decade. Recent examples of erratic weather patterns have been experienced by humans on a regular basis across the world with the Indian subcontinent being no exception.

The rapid growth in industrialised nations which have followed a fossil fuel based economic developmental path over the past few decades has resulted in an exponential increase in GHG concentrations emitted into the atmosphere.

The recently released Fourth Assessment Reports of the Inter Governmental Panel on Climate Change (IPCC) state that there is now a higher confidence in evidence to show that the Earth has warmed even more since 1750 A.D. because of anthropogenic activities. The IPCC also mentions that over the next century, average surface temperatures are expected to rise between 1-6.3 °C depending on various emission scenarios with impacts on health, agriculture, forests, water resources, coastal areas, species and natural areas.

Impacts on high mountain systems including glacial retreat are



*Snout of the Gangotri Glacier, Uttarakhand, India. Photo: G.Areendran*

amongst the most directly visible signals of global warming. One of the most important and visible indicators of climate change is the recession of glaciers in many parts of the World. On a time scale recent glaciations occurred around 20,000 years ago as part of the earth's paleoclimatic history. Although the recession of glaciers has been suggested by some scientists as a natural phenomenon, in the later half of 20th century, an increase in the rate of retreat has been observed in most glaciers around the world including the Himalayas.

The Himalayan region has the largest concentration of glaciers outside the polar caps. With glacier coverage of 33,000 km<sup>2</sup>, the region is aptly called the "Water Tower of Asia" as it provides around 86,000,000 cubic metres of water annually. These Himalayan glaciers feed seven of Asia's great rivers: the Ganga, Indus, Brahmaputra, Salween, Mekong, Yangtze and Huang Ho and ensure a year round water supply to about one billion people.

The changes in climate variability have led to a rapid retreat of mountain glacier systems which are considered the lifeline of river basins and ecosystems. Scientific studies have shown that 67 % of glaciers are retreating at a startling rate in the Himalayas as a result of various factors including climate change.

While there are no true estimates on the total number of glaciers in the Himalayas, inventories by various institutions including the Geological Survey of India suggest that there are well over 5,000-6,500 glaciers in the Indian part of the Himalayas. For example in the state of Uttarakhand, the four sub-basins of Ganga, Yamuna, Bhagirathi and Alaknanda together constitute nearly 900 glaciers. The Uttarakhand region of the Himalayas in India is a hill state with a rich and diverse natural resource base ranging from pristine deciduous and temperate forests to alpine ecosystems apart from several Himalayan rivers, many of which are glacial fed. The Bhagirathi basin in the State of Uttarakhand has around 238 glaciers which cover a glaciated area of 755 km<sup>2</sup> and an ice volume of 67 cubic km. Some of the important glaciers in the region include the Gangotri, Yamunotri, Dokriani, Pindari and Milam glaciers which form important components of the watershed.

Past work by glaciologists and climatologists have found that the accelerated rate of glacial melt in the some of the important glaciers in Uttarakhand will have serious consequences for the freshwater ecosystems of the Ganga basin, with long

term impacts for biodiversity, people and livelihoods as well as regional food security. This will not only mean repercussions on the region's agricultural productivity and industrial activity, but also on the Terai ecosystems and species like the Ganga river dolphin.

### Case study of the Gangotri Glacier

The Gangotri Glacier is the second largest of Indian glaciers and occurs in the Uttarkashi district of Uttarakhand at an altitude of about 4,000 m. For thousands of pilgrims, the Gangotri Glacier is a sacred spot as a major source of freshwater to the Ganga which flows as the Bhagirathi in its purest form.

In recent times the 30 km long glacier has shown considerable recession (average retreat rate of 20-22 m per annum) which has been a cause of concern for both the scientific community as well as the common public. Recent advances in satellite technology have enabled scientists to monitor changes in glacial retreat patterns using a combination of remote sensing satellite imageries. Satellite data has shown that the rate of retreat in the last three decades has been found to be more than three times the rate during the earlier 200 years or so. The recession of the Gangotri Glacier and potential impact from climate change has been a subject of much discussion by Indian scientists. Preliminary observations by WWF India using modern technological methods like Differential Global Positioning Systems (DGPS), indicates that the glacier continues to retreat from its earlier position. It is estimated that glacial melt water which has huge relevance to watersheds and catchments in Uttarakhand could affect future water and power generation scenarios.

### Impacts on water and agriculture

The fertile Ganga region in the Indian subcontinent is bestowed with several important rivers which form part of a larger Ganga basin which has both national and transboundary relevance. The presence of these highly complex river systems indicates the importance of glaciated mountains, which account for most of the glacial melt water. Both glacial melt water and monsoonal precipitation provide a significant component of water resources for different parts of the country. While snow and glacier melt are the major factors in the western and central Himalayan region, rainfall patterns in the eastern part of India are responsible for the changing water regime.



Gangotri valley, Uttarakhand, India. Photo: G.Areendran

Recent studies by scientists have tried to determine the impact of deglaciation on the water resources of the Himalayan region through development of a hydrological model which can depict how local water discharges can respond to future climate scenarios. Consequently, these studies have come out with conceptual models which show increased water availability in some river basins and decreased water supplies in other regions in the coming decades. The glacial fed rivers of Uttarakhand are an important resource for the Ganga basin with many rivers contributing to the irrigation potential of some of India's most densely populated states like Uttar Pradesh, Bihar, Delhi, Haryana etc.

### Impacts on power

Most of the rivers which originate in Uttarakhand have their upper catchments in snow and glaciated areas and traverse through dense valleys and deep gorges. These perennial rivers are an important source for hydel power generation and also supply water to some of the largest irrigation networks of the world. Any changes in river discharge patterns can have profound impacts on the hydropower potential of this region. There are ambitious plans to exploit more hydel power through several micro and mini hydel projects including run-of-the-river power plants which are seen as environmentally friendly. Current estimates suggest that 194 hydropower plans are proposed in Uttarakhand with a planned power generation capacity of about 18,700 MW. This is in contrast to the existing operational capacity of 2,050 MW of power. Changes in the water regime as a consequence of climate change may lead to concerns about energy security due to investment in hydropower development across the state.

### Policy interventions

In the past few decades, continuous impact on the environmental landscape particularly in Uttarakhand in the form of land use practices (water diversions, deforestation, local agriculture practices, industrialisation etc.) have caused large scale impacts on the watersheds of the region. Climate change is expected to further accelerate the adverse impacts on these regions. There is a need to develop and implement local adaptation strategies in order to cope with the changing climate around us. These include alternate livelihood options, research and use of new and better cropping patterns, use of technology through development of early warning systems etc. Various stakeholders ranging from local communities, to academic institutions, civil society organisations and Government bodies and policy makers need to work in an integrated manner to make their regions "climate ready."

It is also important to mention here the impacts of climate change on water resources and deglaciation that will probably be felt most by local and vulnerable communities. Such impacts may drive the poor and the landless to move to urban areas for better employment opportunities imposing further stress on existing urban planning and development.

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WWF Report (2005): An Overview of Glaciers: Glacier retreat and its subsequent impacts in Nepal, India and China. WWF Publication pp 68.

Dr. Prakash Rao ([prao@wwfindia.net](mailto:prao@wwfindia.net)) has 24 years of experience in the field of biological conservation and ecology and current interests include climate change impacts and adaptation research and advocacy in key areas; and ecosystems like the Himalayan glaciers and Sundarbans.

G Areendran ([gareendran@wwfindia.net](mailto:gareendran@wwfindia.net)) heads the Remote Sensing and GIS Division of WWF India, and has research experience for 12 years in ecology and wildlife science with remote sensing and GIS techniques. He has been handling field projects involving mapping of landscapes.

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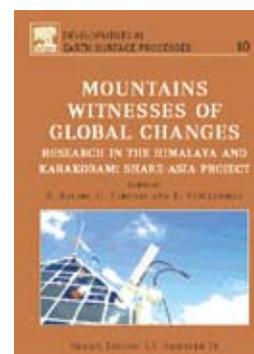
Rajneesh Sareen ([rsareen@wwfindia.net](mailto:rsareen@wwfindia.net)) has seven years experience in urban, environmental and regional sectors including carrying out Environment Impact Assessment (EIA), preparing Environment Monitoring Plans (EMP), preparing energy efficiency solutions, safety audits, water restructuring for river basins and social assessment, focusing on planning, design and management aspects.

WWF India is engaged in a multitude of activities for protection and conservation of the environment in the Indian context. Apart from climate change and energy issues, WWF India also carries out conservation work in areas like forests, freshwater and marine ecosystems as well as focusing on wildlife species of national concern through a participatory approach involving key stakeholders. Through its Environment Education Programme, it aims at strengthening individual and institutional capacity in nature conservation and environmental protection through widespread education and awareness.

### Mountains Witnesses of Global Changes: Research in the Himalaya and Karakorum: SHARE-Asia Project

Edited by R. Baudo, G. Tartari, E. Vuillermoz

Published: J F Schroder / Elsevier Series 10



"Mountains witnesses of global changes. Research in the Himalaya and Karakorum: SHARE-Asia Project" demonstrates the needs and the opportunity for dialogue between major environmental scientists and experts in high altitude research issues. The book highlights the close relationship between the results of in-depth investigations in various disciplines to facilitate comprehension of the environmental phenomena which are determining the health of our planet.

The book contains scientific contributions from the November 2005 Conference "Mountains witnesses of global changes. Research in the Himalaya and Karakorum: SHARE-Asia Project", held in Rome, Italy. The meeting, organised by the Ev-K2-CNR Committee and promoted by the Italian National Research Council, aimed to highlight recent research work in a wide range of disciplines (atmospheric sciences, environmental chemistry, glaciology, limnology). The common denominator to the research presented was its having been carried out in high altitude remote areas, with specific reference to the Himalaya and Karakorum ranges of Asia. Several institutions from around the world have committed hundreds of experts to analysing the pressure of global change on these sensitive mountain regions. Because of its intrinsic fragility, the Himalayan-Karakorum range in fact represents an ideal place for studying long-range pollutant transport and the global-scale effects of fluctuations in the Asian monsoon circulation.

The book aims to contribute to development of an interdisciplinary approach to high altitude environmental research, making evident the synergies in results produced by different disciplines, and demonstrating the need for such an approach in order to better understand the effects of global change on high altitude environments. Along with the papers on high altitude research, it also contains contributions regarding other remote areas of the globe (the Arctic, Antarctica, etc.) pointing out similar approaches to research and helping improve our understanding of mechanisms that are only apparently different.

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## Asia-Pacific Mountain Network

### Project updates (APMN, MPS and MFS collaboration)

APMN is carrying out three different tasks for the Mountain Partnership Secretariat (MPS) facilitated by the Mountain Forum Secretariat (MFS). Under the "Broadband Communication Study", APMN and the Forum for Information Technology-Nepal conducted a survey of the potential of broadband communications to contribute to socioeconomic development of low connectivity areas of the Nepal Himalaya, and organised a workshop on 25 May 2007 to discuss the findings; the final report is in progress. The second task is a "Communication Needs Assessment in Central Asia" which has been carried out in Kyrgyzstan and Tajikistan using a mix of survey and consultative approaches through telephone calls and e-mail contacts to selected stakeholders working in sustainable mountain development. The assessment includes a study of the macro-development environment, IT infrastructure, and institutional and individual capacities. In the final project, APMN is developing communication tools to "Support the Biodiversity Conservation Initiative" of the Mountain Partnership, with a focus in the first instance on the Mountain Twinning Programme between Gran Paradiso National Park (Italy) and Sagarmatha National Park (Nepal). A dedicated webpage is being developed, together with a list serve.



Dr. L.M.S. Palni, Dr. G. Kadekodi and Prof. C. M. Geesteranus at the 4th ICEE in Ahmedabad (from left). Photo: Tek Jung Mahat/APMN

### Supporting pre-conference dialogue on education for sustainable development

APMN with support from the Mountain Forum Secretariat supported an on-line pre-conference dialogue on "Education for Sustainable Development" for the 4th International Conference on Environmental Education held in Ahmedabad, India from 26-28 November 2007. The Conference was organised by the Government of India, with UNESCO and UNEP as co-sponsors, and hosted by the Centre for Environment Education. Tek Jung Mahat presented a summary of the discussion at the main event in Ahmedabad (<http://www.tbilisiplus30.org/index.html>). The text will appear in the upcoming APMN bulletin.

### APMN participation in regional and local events

Dr. A. Beatrice Murray, APMN Coordinator and Acting Head IMCO Division of ICIMOD, participated in the "Knowledge Management

for Organizational Capacity South Asia Region (SAR) Brainstorming Session on Workshop Design and Content" held in New Delhi, India from 5-7 December 2007. The event was organised by the Global Development Network (GDN), in cooperation with the World Bank Institute (WBI).

Mr. Tek Jung Mahat, APMN Interim Node Manager, participated in the 4th International Conference on Environmental Education held in Ahmedabad, India from 26-28 November 2007 and a training course on "ICT for Education Leaders: From Vision to Reality" organised by the World Bank Institute (WBI), the Ministry of Education and Human Resources Development (MOE&HRD), Korea and the Korea Education and Research Information Services (KERIS) in Seoul, Korea held from 12-16 November 2007. He also took part in the National Conservation Day 2007 celebrations in Kathmandu, Nepal on 23 September, jointly organised by ICIMOD, WWF Nepal, IUCN -The World Conservation Union, the National Trust for Nature Conservation (NTNC), Wildlife Conservation Nepal (WCN), The Mountain Institute (TMI), and Wildlife Watch Group (WWG); and in the 4th Asia Regional Conservation Forum (RCF) 2007, also in Kathmandu.

Publicity materials on APMN and Mountain Forum were distributed at these events and other attended by ICIMOD staff, and participants were encouraged to join the network.

### Staff changes at APMN

Mr. Tek Jung Mahat joined APMN as Interim Node Manager from July 2007. Mr. Mahat has an MSc in Environmental Science, with specialisation in mountain environment management, and over five years of experience with NGOs, INGOs, Mountain Forum and ICIMOD.

APMN bid farewell to Mr. Udayan Mishra (Acting Node Manager) and Ms. Sapana Lohani (Intern) in July 2007, both of whom went to the Asian Institute of Technology to pursue a masters' course.

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## European Mountain Forum

### European Mountain Forum in Chambéry

Since 1 October 2007, the European Mountain Forum in Chambéry is operational again, affiliated to the European Association of Elected Representatives from Mountain Regions (AEM). As project manager, Christoph Maier will be dedicating 50 % of his time to EMF activities. The main targets for EMF during the next months will be the development of a business plan for the next three years, as well as preparation for the General Assembly at the begin of 2008. In this context EMF is currently examining the options to launch activities on sustainable mountain development, e.g. an initiative on cultural diversity of European mountain regions and the use of Web 2.0 for efficient dissemination strategies and focussed promotional activities of mountain subjects.

During the last few years Christoph Maier been involved in the development of the international sales of an SME for the industrial measurement and controls sector located near Munich in Germany. Before that, he was in charge of the management of European projects on sustainable development for a research institute in the Bavarian Alps. He has a degree in spatial planning and he has been lucky to complement his interest in mountain issues with on-site experiences in regions as different and exceptional as Aspromonte in Southern Italy, Sierra de Gredos in Central Spain and Lechtal in the Austrian Alps. He is looking forward to manage the EMF activities, he hopes to contribute to the promotion of sustainable development in the European mountain regions.

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## InfoAndina – Latin American Mountain Forum



Tucuman meeting, San Miguel, Peru. Photo: InfoAndina

### San Miguel de Tucuman meeting

As part of the 2007 Letter of Agreement between The Mountain Partnership Secretariat (MP) and the Mountain Forum (MF) Secretariat, InfoAndina (Latin American Node of the Mountain Forum) was commissioned to follow up the results of Lima meeting 2006 and contribute to the organization of the Regional Meeting of the Andean Initiative.

A total of 150 people attended the meeting: 85 % from the host country (mainly governmental institutions) and the other 15% from the focal points and other civil society organisations of the Andes region. Of the latter group, the organisations that participated included: The Mountain Institute - Regional Peru; the Andean Tropical Program - Venezuela, Bolivia and Argentina; the Ecociencia Foundation - Ecuador; CONDESAN - Regional; the High Andes Flamingos Conservation Network - Argentina, Chile, Bolivia, Peru; and the Alexander von Humboldt Institute - Colombia. The Argentine Secretary of Coordination from the government of Jujuy was also present, although he is not a member of the National Mountain Committee.

The meeting included presentations within the four thematic issues, which were:

- > Sustainable Livelihoods
- > Ecosystems Conservation, Natural and Cultural Heritage Preservation
- > Institutional Capacity Building
- > Cross-cutting issues

The subjects presented focused on agro-biodiversity, rural tourism networks, ecosystem conservation, high Andes wetlands conservation, land use planning, natural and cultural resources management and mountain policies.

As part of the round-table groups, there were presentations from special guests: Mountain Partnership, United Nations Environment Program, government officers, Global Environment Facility (GEF), Alpine Convention and CONDESAN. Country representatives from Bolivia, Peru, Ecuador, Colombia and Venezuela introduced the national projects and policies related to mountain conservation and development in their own countries.

An Action Plan was also elaborated by the Organizing Committee of Argentina and the collaboration of representatives from

Ecuador, Bolivia and Peru, with inputs from MPS and CONDESAN-InfoAndina.

More information: <http://www.infoandina.org/site.shtml?apc=Cc--i1-&x=18109&i=8eb43ef57a7e7bd7f955e639e83e0223>

## Contributing to the information management in the Andes

Regarding the support activities of InfoAndina to different initiatives and projects, this year has been very productive.

### 1) PDRS portal (<http://www.gtz-rural.org.pe>)

The Rural Sustainable Development Program (PDRS) from GTZ is an initiative with the purpose to increase the ability of the poor population of Peru to improve their quality of life through the sustainable management of natural resources.

In May 2007 InfoAndina and PDRS signed an inter-institutional agreement to develop and create a new dynamic website for them. It's a big project that we are working on and in the next month we are going to have an online website.

### 2) RENACAL portal (<http://www.renacal.org.pe>)

The National Institute of Natural Resources (INRENA) in the name of the National Network of Regional and Local Protected Areas (RENACAL), in August 2007 signed an inter-institutional agreement of collaboration for the creation and development of the RENACAL website as a primary mechanism of communication related to the activities of this network in support of the sustainable conservation of the protected areas in Peru.

RENACAL is made up of different actors from civil society, the public and private sectors and cooperative agencies with the objective to be a communication platform to improve, promote and disseminate experiences in conservation and biodiversity management.

We are in the final phase of this process and in the next month we will have a new RENACAL website.

### 3) RAMP PERU (<http://www.ramp-peru.org.pe>)

RAMP PERU is a project that, through programs to strengthen and support innovators and inventors, promotes the development of technological products to improve the living conditions of the poor in the Peruvian Andes.

We, as an information platform of CONDESAN, have created and developed the website related to this and it is now online.

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## North American Mountain Forum

### Understanding and managing amenity-led migration in mountain regions

Preparations for the May 2008 conference: Understanding and Managing Amenity-led Migration in Mountain Areas are underway. The conference will bring together scholars and practitioners from around the world with an interest in communities impacted by in-migration - specifically, when people come for the beautiful landscapes and other amenities so common in mountain areas.

The conference is designed to explore the current state of knowledge about amenity migration, to gather existing and proposed ideas for planning and management, and to draft guidelines that will help mountain communities to manage the changes that come with amenity-led migration. Researchers, land managers, community administrators, and political representatives will discover common ground for developing positive solutions.

An electronic resource network will be established concurrently to assist conference-goers - and those who cannot attend - in sharing ideas and solutions to the challenges they face in their own mountain communities.

For more information [http://www.banffcentre.ca/mountain\\_culture/mtnconferences/am/](http://www.banffcentre.ca/mountain_culture/mtnconferences/am/)

### Mountain Partnership Secretariat decentralised hubs

The Mountain Partnership is a voluntary alliance of partners dedicated to improving the lives of mountain people and protecting mountain environments worldwide. It is similar to Mountain Forum in that it builds relationships between mountain stakeholders - it differs in that it focuses more on partnership-building than information-sharing and involves only organisations, rather than individual members. The Mountain Partnership Secretariat is the networking and liaison point for members of the Mountain Partnership. The Secretariat connects people and activities by providing services in communication and information, knowledge management and brokerage.

The department of Mountain Culture at The Banff Centre, in Banff, Alberta, Canada, has agreed to become a decentralised hub of the Mountain Partnership Secretariat in North America beginning in early 2008. It will join other decentralised hubs in Latin America and Asia to promote and broker partnerships between mountain stakeholders.

For more information contact Amy Krause at [amy\\_krause@banffcentre.ca](mailto:amy_krause@banffcentre.ca).

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## Mountain Forum Secretariat

### Mountain Forum Secretariat staff changes

The last few months have seen a lot of changes in the Mountain Forum. The Mountain Forum Secretariat is sad to see Ana Maria Ponce, Executive Secretary of the Mountain Forum leave in February, after finishing her three year term.

Coming from the Latin America Mountain Forum, Ana Maria has played a leading role in building up the Mountain Forum Secretariat to what it is today, both in terms of strategy and securing vital funding. She has forged close relationships with the Mountain Partnership and Mountain Institute. The Mountain Forum wants to thank her for the positive contributions and wishes her much success for the future.

Ana Maria is succeeded by Francis Neuman from the Netherlands, who will be joining the Mountain Forum Secretariat in January 2008. He brings with him expertise in knowledge management and networking in a variety of fields around the world. With a background in agriculture and development, Francis comes to the Mountain Forum from the IICD (International Institute for Communication and Development) where he focused on synthesising lessons learnt and fostering the use of ICTs in development processes. He is warmly welcomed to the Mountain Forum Secretariat.

The Mountain Forum Secretariat was also sorry to see Elizabeth Fox leave her post as Programme Assistant, Information Services. She has been replaced by Marianne Heredge. As Programme Officer, Marianne's role will be to continue the development and maintenance of the on-line library and edit the bi-annual Mountain Forum Bulletin.

Leaving a few weeks later, Prashant Sharma, Deputy Executive Secretary and Communication Manager and Celine Curi, Programme Development Officer who both arrived together over four years ago. Prashant is studying for a PhD in knowledge management at the London School of Economics. Both Prashant and Celine played vital roles in the Mountain Forum and will be very much missed.

In September, two new interns have joined the Mountain Forum: Shreeza Rajbhandari, with a Masters in Development Studies from University of Wollongong, Sidney, Australia. Shreeza works on maintaining the information shown on the Mountain Forum website. Prabin Gurung started at the same time. He has a background in media and technology, having studied in Bangkok, Thailand for his degree. Prabin looks after the membership of the Mountain Forum and information shown on the website.

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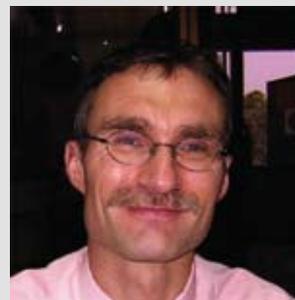
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### Frans Neuman

With great pleasure I accepted the position of Executive Secretary of the Mountain Forum, though bearing in mind the challenge of succeeding Ana Maria who was so instrumental in developing the Forum. As Technical Advisor for the Netherlands government I dealt with international agriculture research especially the ecoregional programs as CONDESAN and the African Highlands Initiative. Important was the focus on multi-stakeholder involvement for addressing a geographically-focused agenda. Learning in and between regions was identified as a need. The last decade I carried out projects with regional networks and national partners in various continents. These focused on the use of ICT, knowledge management and networking mainly in the area of sustainable agriculture, natural resource management.



It is heartening to see the increasing recognition of ICT and knowledge management. However much has to be done to make it work as tools for sustainable development. Linking 'ICT & Knowledge' policies to practical application I find important. Strengthening human capacity and building up ICT infrastructure needs attention. With IICD I supported guides on the options and costs of internet access and renewable energy in several countries. As developments are rapid and take place in different locations there are great opportunities to learn from each other. Networks that capture this and allow sharing among its members add value.

The set-up of the Mountain Forum as a structured network-of-networks with its many members is an achievement the MF can be proud of. The importance of the mountain regions for major global challenges is clear. Topics such as water management, biodiversity, sustaining mountain livelihoods especially in the context of climate change, and indigenous cultural heritage, will dominate the national and international development agendas in the next decades.

The MF is well positioned to play a constructive role in these processes. In 2008 we will jointly define the program for the coming years. I like to share with you a few ideas on areas that need our attention in the coming years:

- > Assure availability of key information and foster interaction of interest groups on key thematic areas. The collective knowledge and expertise of the Forum can support input of members in international and national policy processes .as well as in implementation of activities. Successful approaches can inspire innovation for sustainable development in other locations.
- > Strengthen the capacity of MF members to actively use information and ICTs to participate in processes and improve their livelihoods. This relates to human capacity and infrastructure. The regional networks can play key role in supporting members .

The need for consolidated action is obvious. The MF offers a great mechanism to positively contribute to sustainable and equitable development. With these introductory remarks I hope to have triggered your interest for debate on the way forward. I'm looking forward to a period of fruitful cooperation with you.

Frans Neuman  
Nominated Executive Secretary, The Mountain Forum Secretariat

### Children's Movement for Mountain Environment Conservation

*Aftab-ur-Rehman Rana, Pakistan Adventure Foundation*



*Dr. Kishwar giving lecture on mountain flora, Pakistan. Photo: Gulraiz Ghori*

I would like to share my personal experience of starting an environmental education program with members of the Mountain Forum. I started this program under the title of "National Children Mountain Conservation Meet" on the occasion of the International Year of Mountains 2002 with a view to educate young people of my country about the unique mountain ecosystems by involving them in meaningful practical activities using mountain environment as an open classroom. Under this program, each year 120 children are selected from all parts of Pakistan including Northern Areas and AJK to attend a 10 day environment education camp during the summer holidays. Forty to fifty children from remote areas and far-flung mountain valleys get full scholarships to participate in this program.

This educational program involves young children in an action-oriented form of learning about the natural environment and its related problems. During their ten days' expedition, they go on various mountain trails under the supervision of trained mountain wilderness guides and resource persons to have a first hand experience of the mountain environment. They learn about the unique plants, birds, insects and other animals. They meet local people and learn about their lifestyle and culture. Beside this they jointly work in smaller groups on some community projects such as cleanup of polluted mountain streams and alpine lakes, tree plantation on denuded mountain slopes, improving water channels, repairing walking trails etc. The other aspect of this activity is bringing children from different cultural and social backgrounds to one forum so that they can develop a spirit of national integration and resolve cultural differences.

When these children go back to their homes, they are conscious enough to do something practical for the conservation and preservation of the natural environment by undertaking micro-level projects in their communities and schools. The children who attend this program are given the title of "Eco-Guards" which gives them confidence to play an active role in their day-to-day life to create awareness about protection of the natural environment and its important role in our daily life.

So far six children meetings under this project have been held in different mountain areas of Pakistan and more than 700 young

participants and 200 adult volunteer staff members from all over Pakistan including children from far-flung areas of Hunza, Gojal, Chitral in the north and Lasbela in the extreme south have participated in this program. It is now an annual event of Adventure Foundation Pakistan and is now supported by GEF-Small Grant Program of UNDP and some other co-sponsors.

I think this small initiative have set a good example by providing young people to go on a journey to get closer to Mother Nature and harbour the love that is due to her for all that Nature does for us in life. Just reading heavy books and memorising difficult scientific or mathematics formulas by heart can not serve the purpose. The knowledge and skills children gain in this 10-day camp is far more than many years of class room studies.

If any one is interested to know more about this model or follow this concept, I will be more than happy to help.

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Aftab-ur-Rehman Rana ([afopak@yahoo.com](mailto:afopak@yahoo.com)) is Vice President of the Adventure Foundation Pakistan.

Adventure Foundation Pakistan is an open membership, non-commercial, private organisation, registered under the social welfare ordinance. It is dedicated to the promotion of outdoor activities for the youth guided by the outward bound principles and concepts an action oriented educational system.

### Moving Medical Corp Helps Over 1,000 People

*Mountain Fund*



*Examining patients at the medical camp, Rasuwa, Nepal. Photo: The Mountain Fund*

A team of health professionals travelled to Nepal in October with the ambitious goal of trekking the little known Tamang Heritage Trail and providing free health care to thousands of Tamang people living in the remote Rasuwa District. Visiting seven villages along the trekking route the team established formal medical camps in Gatlang, Chilime, Timure and Syabru Bensi and saw additional patients in Tatopani as well.

## Member Initiatives

The trip began for most of the participants with 24 hours of air travel from the US to Nepal. The Mountain Fund/KFK staff met the team at the airport and we boarded a rented bus to transfer to the Hotel Ambassador, our Kathmandu base. The second day in Kathmandu was spent sorting the boxes of medicine, eye glasses, medical supplies and camping equipment. The following day the group boarded a bus bound for Gatlang. Though only 120 km from Kathmandu, the trip to Gatlang normally takes 10 hours over rough roads. This time the trip took nearly 15 hours however owing to a large landslide which had closed the road. When we arrived at the landslide area the medical team all walked around the construction that was underway as two large road-working machines attempted to open a path for our bus. In the end, over 30 porters tied a rope to the bus and pulled it up the final hill. It had taken two hours to make it 1 km but the way ahead to Gatlang was now open.

The team arrived late in the evening at the trekking lodge which has recently opened in Gatlang and after a hasty dinner called it a day so we'd be rested for the medical camp there the next morning. Between 200 and 300 villagers turned out for medical care and were all seen by the end of the day. From the first camp it was obvious that Pete Korpi, an Optometrist from Muscatine, Iowa was much in demand. Assisted by his daughter Katie, Pete saw over 225 patients and prescribed over 175 pairs of glasses.

The most common complaints were vision problems, intestinal parasites, wounds and women's health. Dr. Dorothy Kammerer-Doak of Albuquerque, New Mexico who is an OBGYN specialist saw the women while her husband Bob Doak took charge of medicine for intestinal parasites.

After Gatlang we packed everything up and walked a few hours to the Chilime damn site where we set up for another camp. We used two Mountain Hardwear space stations as our primary medical buildings and some borrowed space in the local school for our pharmacy. The pharmacy was staffed by Shelly Ogle and Ann McCollum, both from Albuquerque, New Mexico and Sudha Dhungana, a nurse from the Karing for Kids clinic at nearby Goljung. The pharmacy was constantly busy dispensing medication and translating instructions from English to Nepali and then into the local language, Tamang. A tedious process made possible by a really dedicated group of interpreters who travelled with us.

Dr. Beth Hall-Thompson from the UK and Lindsey Mahlstedt from Albuquerque took the front line triage positions and directed patients to wound care, headed up by Susie Rivard and Tu Mach and the general medicine tent staffed by Nepali Doctor Alish Prajapati. Each patient selected by the triage team was first seen by the intake team of David Diaz and Kerry Flint from Albuquerque, New Mexico. Tina Quack of Albuquerque, saw patients needing respiratory therapy and Michael Falcone helped direct patients from one area to the next.

The logistics didn't end with how to triage and care for over 1000 people while trekking. In all 42 porters, a kitchen staff of 11, three Sherpas and one Sirdar were employed to move the team down the trail. A team of 82 people in all.

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The Mountain Fund organises grassroots non-profit and non-governmental organisations from a diversity of disciplines, to support and coordinate these organisations' efforts to eliminate poverty, its causes and symptoms, in developing mountain communities around the world. For further details, visit <http://www.mountainfund.org> or contact [mtfund@mountainfund.org](mailto:mtfund@mountainfund.org).

## Potential Source of Conflict in the Alps: Use of Water for Artificial Snow Production

*Mountain Wilderness*



*MW Germany - Demonstration in Garmisch-Partenkirchen (March 2005). Photo: Mountain Wilderness*

First developed as a means to allow the return of skiers to the resort while skiing, artificial snow's production has quickly become an essential part of the mechanised ski industry. The growing use of snow guns in the Alps' ski resorts is increasing and more often seen as a threat to the other uses of water in the mountains (agriculture, drinking water...).

At the present time and according to a 2004 synthesis report published by the International Commission for the Alps' Protection (CIPRA), more than 27 % of the ski tracks in the Alps (240 km<sup>2</sup>) are equipped with this kind of equipment. The figures reach 40 % in Italy and Austria. More often seen as the only possible answer to global climate change and the related lack of snow, the use of snow guns is growing fast in the European mountains.

The production of artificial snow needs water - a lot of water. A cubic metre of water can produce between 2.5 and 3 cubic metres of artificial snow. With a minimum depth of 30 cm, this can cover only 8 to 10 m<sup>2</sup>. An estimate of the real consumption is 4,000 cubic metres of water per hectare. As a comparison, maize culture, which is one of the most water-demanding, consumes 1 700 cubic metres/ha. The total water needed for artificial snow production in the Alps is about 100 millions cubic metres, which is the equivalent of the domestic water consumption of a town with 1.5 million inhabitants.

Most of this water is taken from rivers, springs and drinkable water reservoirs. But these are the water sources for most of the human settlements living downstream. And it is easy to understand that conflicts are around the corner or already present between the tourism operators of the ski resorts and the other users. In France, the small town of Vaulnaveys, situated downstream of the big resort of Chamrousse, which comprises 100 % of ski tracks with snow production equipment, has officially taken a stand against the building of a 45,000 cubic metres reservoir. This new dam in Chamrousse would compromise the availability of drinking water in Vaulnaveys.

For the natural environment, the consumption of water for artificial snow production is not harmless. Water is mostly removed in January and February, when water courses are at

their lowest level. And this has, of course, a strong impact on fish and batrachians.

Since the natural sources of water, rivers, lakes and ground waters are more and more insufficient for the production of all this artificial snow, resort operators are building a growing number of reservoirs. These reservoirs are situated, of course, on the rare flat areas in the mountains, where there are commonly natural lakes or peat bogs. Their construction leads to the destruction of these fragile ecosystems. And they constitute also offences to the landscape, which is one of the main attractions in mountains areas.

In the face of this strong tendency and the huge investments made in artificial snow production, environment protection associations are mobilising. Basing their demands on considerations of conservation of resources (water and energy), nature protection, but also landscape maintenance and social equity, they ask for a moratorium in the building of new developments in the Alps and the implementation of European water legislation, meeting, among other considerations, the need to define priorities in the use of this scarce resource.

Mountain Wilderness which is very active in the Alps, with its French, German, Italian, Slovenian and Swiss associations, is in the frontline of the struggle. A short review of some recent actions shows clearly the commitment of the international association to fight these destructive attitudes.

Mountain Wilderness France has published at the end of 2005, a document on snow guns, titled "Eau secours!" The association has signed in December 2006, along with other mountain associations, a letter to the French government requesting specific legislation for artificial snow production. In July 2007, Jean-Pierre Courtin, Chairman of the association, intervened against the High-Savoy authorities, to condemn the destruction of La Flaine's karst by the ski resort that had been undertaken in the hope to find new ground waters.

In Germany, a study has been undertaken on the impacts in summer of artificially snowed tracks. A demonstration has taken place in the spring of 2005 against the building of new installations in Garmisch-Partenkirchen, in preparation for the World Ski Championship in 2011.

Mountain Wilderness Slovenia is a signatory of the November 2004 "Memorandum on protection of the Triglav National Park" which condemns, among other things, the use of artificial snow production in the Triglav National Park perimeter. Mountain Wilderness will keep on its action stop this water use and expect that the national and European authorities to take stock of the problem and the associated risks.

(The opinion expressed and the arguments employed herein do not necessarily reflect the official view of the ONERC or the French Government.)

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Mountain Wilderness France - Eau secours ! - Ed. Mountain Wilderness France (December 2005).

Coalition for protection of the Triglav National Park - Memorandum on protection of the Triglav national park - <http://www.mountainwilderness.si/en/activities/campaigns/campaigns-in->

*2004/memorandum-on-protection-of-the-triglav-national-park?searchterm=Triglav+memorandum* (November 2004).

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Hugues Thiebault ([coordination@mountainwilderness.org](mailto:coordination@mountainwilderness.org)) is the Mountain Wilderness General Secretary.

Mountain Wilderness unites the alpinists throughout the world for the protection of the mountains. The main areas of work of Mountain Wilderness are: mountain protected areas, glaciers protection and ski resorts, struggle against motorised leisure in nature areas, eco-tourism, obsolete installations in mountains and impact of mountain sports.

## Mountain Academy Nepal

*Dorjee Jangbu Lama*



Saleri, Solukhumbu, Nepal. Photo: Marianne Heredge

The Mountain Academy Nepal (MAN) is an undertaking of the Ministry of Culture, Tourism and Civil Aviation, Government of Nepal for the development of the mountain regions of Nepal with a view to promote international tourism. Building of a mountain training centre and museum is being planned near to Saleri, at Garma VDC, Solukhumbu, south of the Everest trekking region. At the training centre, accredited mountain instruction will be given to mountain guides. A museum of ethnography will be set up, focussing on the culture of the peoples who inhabit the mountains in Nepal. A statue of a mountaineer will be kept in the centre as a mark of respect for their contribution. There will be a tea garden and all the activities will focus on mountain studies, development and training quality guides who meet international standards.

Recently, Mountain Academy Nepal conducted a seminar in Saleri, Solukhumbu for the development of the Mountain Training Centre and to prepare its Master Plan. For further information: <http://www.man.gov.np>.

## Member Initiatives

A member of the Mountain Forum, Dorjee Jangbu Lama is working as the Member Secretary of Parbatiya Prashikshen Pratishthan Bikash Samiti (Mountain Academy Nepal). He was born in Junbesi Solukhumbu district and came to Kathmandu for his higher education under a scholarship program provided by the Himalayan Trust. If you have any questions about the project, please contact [mountainnepal@wlink.com.np](mailto:mountainnepal@wlink.com.np).

### Balkans Peace Park Project In Running For Top Tourism Award

*Balkans Peace Park Project*

Peace Park nomination now among three finalists in competition for award from the British Guild of Travel Writers.

Last autumn community leaders from valleys in northern Albania and adjacent areas of Kosovo and Montenegro met in Pristina (Kosovo) to mark their support for creating an international peace park in the mountainous region where their three territories converge.

Now, less than a year later, the Balkans Peace Park Project (BPPP) finds itself in the running for one of Britain's premier tourism awards as one of three finalists for an award from the British Guild of Travel Writers (BGTW). That was agreed at a Guild meeting held in London on Wednesday 12 September.

'The land of the living past', is a phrase coined by Edith Durham who one hundred years ago travelled through the remote valleys and mountains that now lie at the heart of the Balkan Peace Park region. Edith Durham recorded her travels in a celebrated piece of travel writing called High Albania.

The BPPP helps unite communities that have hitherto been divided by common borders and makes a stand against environmental degradation. It promotes the effective protection of a region that has mountain landscapes and rural lifestyles which are not replicated elsewhere in Europe. The project also promotes access to the region for ethical and responsible tourism in one of Europe's remotest areas. Above all, the project is a powerful agent for peace in a region of Europe where ethnic tensions have still not been entirely resolved. The BPPP benefits from support from a number of non-governmental agencies and individuals besides the six municipalities and some government ministries.

Representatives of the three finalists are invited to attend a gala dinner at London's Savoy Hotel on Sunday 11 November, on the eve of the World Travel Market - and there the winning project is announced. 2007 is the thirtieth year in which the BGTW (many of whose members are among Britain's most accomplished travel journalists and authors) has made an award for the best overseas tourism project. The criteria are simple: the project must be genuinely innovative, it must be sensitive to environmental and ecological concerns, and it must make a positive social contribution. At their best, such projects allow for interested travellers to explore landscapes, communities and cultures which might otherwise be off-limits.

For more information on the Balkans Peace Park Project, go to [www.balkanspeacepark.org](http://www.balkanspeacepark.org). The award programme is sponsored

and organised by the British Guild of Travel Writers (<http://www.bgtw.org>). BPPP was nominated for the 2007 award by Nicky Gardner of hidden europe magazine (<http://www.hiddeneurope.co.uk>).

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Balkans Peace Park Project works to create a trans-national, cross-border park in the unique adjoining mountain areas of Albania, Kosovo, and Montenegro. The establishment of the park involves not only protecting its biodiversity and enhancing the environment but helping with self-sustaining development in the region, based on eco-tourism.

Media images and interviews available on request to Antonia Young ([a.t.i.young@bradford.ac.uk](mailto:a.t.i.young@bradford.ac.uk)), Chair of BPPP-UK.

### Livelihoods and Conservation of Medicinal Plants:

*Applied Environmental Research Foundation*



Farmers from Ghese in their *Picrorrhiza kurrooa* field, India. Photo: Archana Godbole

Medicinal plants are important commodities that have been exploited for the betterment of the human race throughout the world. India with its ancient medicinal systems like Ayurveda and other indigenous systems like Unani, Siddha and Amchi is well known for the use of medicinal plants since time immemorial. The Himalayas are a treasure trove due to various ecosystems and diverse habitats.

Medicinal plants collection has been an equally old livelihood activity of communities in remote mountainous areas. Medicinal plants are contributing to the major trade undertaken in the Chamoli district in the state of Uttaranchal.

However the medicinal plant sector is unorganised. The benefits of collection from the wild are not reaching the poor. Due to urbanisation and pressure on ecosystems like Bugiyals; the high altitude medicinal plants are depleting and many of them have

been already listed in the IUCN Red Data Book as endangered. There is a need for awareness and capacity building among local people and various other stakeholder groups involved in the medicinal plants sector in the Himalayas for the long term survival of this important plant resource.

### Medicinal plants from Himalayas

The Himalayan region is particularly well endowed with medicinal plant species. This is largely because of the diverse agro-climatic conditions which exist in the region. These vary from dry deciduous forests and alpine meadows in the north-west, to rain forests in the north-east.

A large number of people in the Himalayan region derive employment and income from the collection, processing and trade of the plants. Unfortunately, the increase in demand as also increased the threat of depletion from wild. With this background it is clear there needs to be interventions that involve local communities from the Himalayan region in the sustainable development of the otherwise unorganised, underdeveloped medicinal plants sector.

The problems of this unorganised sector of medicinal plants are many, but the most important problems are that of awareness, synergy, institutional understanding and the need to search for workable options to resolve these issues.

Sustainable harvesting is increasingly being seen as the most important conservation strategy for most wild-harvested species and their habitats, given their current and potential contributions to local economies and their great value to harvesters over the long term. The basic idea is that non-destructive harvests and local benefits will maintain populations, species and ecosystem diversity.

Besides poverty and the disintegration of traditional restrictions, the major challenges for sustainable wild-collection include lack of knowledge about sustainable harvest practices, undefined land use rights and lack of legislative and policy guidance.

The Applied Environmental Research Foundation (AERF) has been engaged in a project 'Capacity building for linking medicinal plants conservation and sustainable livelihoods in Western Himalayas, India since July 2006 with financial support from Plant Life International UK through their Plant Conservation and Livelihoods Initiative under the Allachy Award Medicinal Plants Conservation Programme.

This one year intervention has been designed for raising awareness levels to motivate communities, to develop sustainable harvesting methods for medicinal plants collected from the wild and to familiarise local communities with the medicinal plants market and provide authentic information about the present status of medicinal plants in wild. There is a need build the capacity of local people for using the medicinal plants sustainably. The AERF has worked with local communities through information sharing, awareness generation, focus group discussions and trainings in high altitude villages from Chamoli district of Uttaranchal from India .

There are many challenges to improving the well-being of people who depend on medicinal plants from the forests and high altitude meadows of the Himalayan region. These include:

- 1) Expanding natural resource based employment and income opportunities;
- 2) Finding ways to monitor and arrest the resource depletion from negatively affecting livelihoods; and

- 3) Identifying conservation strategies that favour livelihoods while achieving conservation.

This one year intervention has made the following significant impacts:

- > Awareness about medicinal plants sector in terms of conservation has increased among the communities and other stakeholders like small traders, NGO personnel and Government agencies.
- > Dissemination material in the form of posters, brochures, etc. has been prepared and used by local people. The project has helped to provide information on medicinal plants in Hindi.
- > Local people's capacity to respond to markets and share the concerns has increased in the project villages in Ghat & Dewal Blocks from Chamoli district.
- > Basis for developing medicinal plants-based livelihoods has formed and communities are now looking for more precise facilitation and support for developing medicinal plants based livelihoods.
- > Through stakeholders workshops the stakeholders are involved in the process and are ready to participate in the further interventions.
- > Training on medicinal plants conservation needs, its livelihood perspective and sustainable harvesting has helped in increasing awareness about the *in situ* conservation of endangered medicinal plants.
- > The project has provided an opportunity to far reaching villages from the interior areas to initiate NRM based livelihood activities and support .

### Reference

A detailed report of the stakeholders' workshop is available at: <http://www.plantlife.org.uk/international/assets/med-plants/projects-case-studies/AERF%20project/AERF-workshop-28-29-Apr-07.pdf>.

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Dr Archana Godbole ([archanagodbole64@gmail.com](mailto:archanagodbole64@gmail.com)) has a background in botany and the environment. She is an honorary director at the Applied Environmental Research Foundation where she is involved in project preparation, execution planning and management of research, monitoring and evaluation of work, team-leading and writing research papers and reports.

Applied Environmental Research Foundation (AERF) has been engaged in community based conservation work for more than a decade in India. AERF is a registered non-government organisation that undertakes research and implementation projects in the Western Ghats in western India and the Indian Himalayas.

More information about the project can be obtained from:

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## Member Initiatives

### Summer Environmental Exchange (SEE) 2007

Farmer Tantoh



Lake Tahoe, USA. Photo: Mosimann

The Summer Environmental Programme (SEE 2007), organised by the Tahoe-Baikal Institute (TBI - <http://www.tahoebaikal.org>) was a turning point in my life. I learned about it from the Mountain Forum online library and had to apply in early January 2007. When I was selected as TBI's first participant from Africa, I could not believe my eyes and thought that it was a joke. With limited financial resources, TBI organised a fund-raising event for me via the internet and 60 persons - WWOOF Volunteers who worked with me in Cameroon, their families, friends, TBI Board of Directors and Alumni - supported me to come for this programme. I started realising how highly the work I have been doing in my community is appreciated by people in the wider world. Being my first time to travel internationally, I thought I was going to another planet, for the Western World is really a different world with respect to most African countries.

During my time spent with the 17 other participants, I really learned a lot, as our activities were focused on studying two beautiful lakes: Tahoe in the USA and Baikal in Siberia and their watersheds. My project in Tahoe was examining baseline water quality for the Upper-Truckee watershed and other streams flowing into Lake Tahoe. We examined about 15 sites where we carried out water quality tests and took depth, width and flow measurements. We also performed a riparian habitat assessment, in which we walked ¼ mile upstream and recorded observations about the riparian corridor (including vegetation, wildlife and physical characteristics of the stream); and drew a detailed map of the stream.

While in Siberia, my project in Bolshie Koti settlement, Irkutsk was a sociological research project on the development of tourism in the Bolshi Koti District: 'Assessment and Projections on the Western shores of Lake Baikal'. This is the most beautiful lake I have ever seen in my life. It is the deepest, largest fresh water lake in the world (636 km long, 14 to 81 km wide and 1.6 km deep).

In Ulan Ude in the Buryatia Republic, I also participated in a project on sacred places in the Barguzin Valley. We visited the Buddhist and Shaman sacred places which were located around springs. All the springs have minerals which have healing properties. We saw springs that are good for the stomach, heart diseases, eyes, lungs etc. Before approaching each sacred site,

we had to observe some rules (where to put coins, cigarettes, matchsticks; be quiet; move around the temple three times etc). All these sacred places helped me to understand how the Buddhist religion plays an important role in nature protection especially spring water resources. We also have sacred places back in Cameroon located around traditional places. These places are restricted and only certain elders of the palace can visit the site. We also volunteered with the following organisations and government agencies and carried out hands-on ecological restoration work:

- > Yosemite National Park, California where we assisted in the removal of wild strawberries that are colonising other plants in the park;
- > California Tahoe Conservancy (CTC) where we assisted in cutting trees that were too close together to prevent damage by wildfires and laid straw on footpaths for hikers, hence preventing erosion;
- > Great Baikal Trail (GBT), Irkutsk where we assisted in digging trails for hikers to ease movement through the Bolshie Koti settlement. The inhabitants of this village do not want a motorable road to come to their settlement for they do not want too many tourists coming there, as they pollute their environment and the lake with a lot of trash and noise etc.

As well as working on the projects, I also interacted with people of different nationalities, cultural backgrounds, ate strange food and this made me change my perception of how I thought about the world. The various meetings we had with various NGO's, government agencies and also visiting tourist sites changed my views in so many ways. I met many people who were interested to support SYFA back at home to expand our activities. I met many students from Uni-Reno Nevada who were interested to come for well drilling in Nkambe next summer and many others who shall be coming on exchange programmes and on internships with SYFA.

I believe that the experiences gathered during the SEE programme will help me to continue with watershed management sensitisation and nature protection in the rural communities in my region. "Seeing is believing" and "travelling is learning". This world is really a small village.

Thank you all who made this dream come true for me, especially the Mountain Forum for advertising TBI. Let us join hands together to work for the long term sustainability of our planet-earth.

Back at home, we are in the process of buying, renovating and equipping a SYFA Resource Center and need support so as to start training programmes with the rural masses. We have also started an agro-forestry nursery. Our botanical gardens at Chua-Chua-Nkambe are improving and the flowers are blooming. Some of the flowers now attract humming birds and many others and this is a giant step in biodiversity conservation. Primary schools in Nkambe now come for excursions to learn about flowers and nature protection. This has stimulated many children and youths in the whole of Nkambe community to engage in planting of flower gardens and lawns all thanks to the garden. Some come and work at the garden in exchange for plants. However, we still need support to expand this project for we have done just 1/10th of what we had in mind.

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## Geo-referenced Biological Databases: A New Mountain Biodiversity Tool

*Global Mountain Biodiversity Assessment (GMBA)*



High andean plant diversity, Cayambe, Ecuador, 4600 m. Photo: Christian Körner

Geo-referenced archive databases on mountain organisms are very promising tools for achieving a better understanding of mountain biodiversity and predicting its changes. The Global Mountain Biodiversity Assessment (GMBA) of DIVERSITAS, in cooperation with the Global Biodiversity Information Facility (GBIF), encourages a global effort to explore biodiversity databases on mountain organisms.

Many research projects generate data sets that are relevant for the scientific community, government natural resource managers, policy makers and the public. There is an urgent need to increase the amount and quality of geo-referenced data on mountain biodiversity provided online, in order to meet the challenges of global change in mountains. The Global Biodiversity Information Facility (GBIF) has already established biodiversity information networks, data exchange standards and an information architecture that enables interoperability and facilitates mining of biodiversity data. GBIF's technical expertise is an essential prerequisite for projects like this one. GMBA is about to create a specific GBIF data portal on mountain biodiversity and encourages mountain biodiversity researchers to share their data within GBIF, in order to increase the amount and quality of geo-referenced data on mountain biodiversity provided online. When building or analysing database information, it is essential to include geographical coordinates and altitude specifications (geo-reference) of observed or collected biological species, as it allows to link biological with geophysical information, particularly climate data.

The wide range of climatic conditions and topographies across the world's mountains offers an unparalleled opportunity for developing and testing biodiversity theory and predicting its changes. The power of openly accessible, interconnected electronic databases for scientific biodiversity research, which by far exceeds the original intent of archiving for mainly taxonomic purposes, has been illustrated in a GMBA Research Agenda (Körner et al 2007). This Research Agenda is one of the outcomes of a GMBA workshop in the Central Caucasus in July 2006, bringing together the expertise of mountain biodiversity researchers and data base experts. A second was held in Copenhagen with GBIF in October 2007. GMBA will follow up on these issues in order to reach a synthesis of regional mountain biotic richness from various parts of the world.

The EUROMONT initiative is one of many scientific projects that collect and use large geo-referenced mountain biodiversity data sets to answer specific questions in ecology, biogeography and conservation biology. EUROMONT aims to assess climate threat to alpine plant diversity in Europe. A recent paper by Thuiller et al. (2005) predicted species loss up to 60% for mountain plant species in Europe in response to climate change. These coarse-resolution (10'x10') projections provide valuable scenarios for anticipating risks that climate change exerts on overall biodiversity in Europe. But their accuracy may not be sufficient to assess ecological impact in complex high-elevation mountain landscapes, where the rugged topography requires high resolution mapping (e.g. 25x25m; Guisan & Theurillat 2000). As these predictions are then used to address management issues, such as the role of parks and natural reserves as reservoirs of future biodiversity (Araujo et al. 2004), it has become urgent to assess whether reliable local trends can be predicted from these global projections. EUROMONT recently gathered plant distribution data at the fine scale for 11 study areas across six mountain ranges, this way allowing the local assessment of climate threat to mountain floras in Europe. These data sets from six mountain ranges (Alps, Apennines, Pyrenees, Scandes, Scottish highlands, Carpathians) clearly showed distinct sensitivities to climate change. Responses differed largely between study areas, depending on their species pool and climate sensitivity. First results show on average smaller extinction rates at the local scale, due to some species finding refuges at high elevation, but even higher extinction rates than predicted at the European scale can also be observed for some species under severe climate change scenarios. Nonetheless, all extinction rates remain important (above 10 %) and show that all mountain floras are vulnerable, especially when considering the most severe climate change scenario (up to > 60 % extinctions).

### Internet

GMBA (Global Mountain Biodiversity Assessment): <http://www.gmba.unibas.ch>

EUROMONT: <http://www.unil.ch/ecospat>

DIVERSITAS: <http://www.diversitas-international.org>

GBIF (Global Biodiversity Information Facility): <http://www.gbif.org>

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## Member Initiatives

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Global Mountain Biodiversity Assessment (GMBA) is a cross-cutting research network of DIVERSITAS with the task to explore and explain the great biological richness of the mountains of the world. GMBA synthesises the often hidden and fragmented results of research on mountain biodiversity and advocates studies on the human influence on natural and cultural landscapes in the mountains.

### Ev-K2-CNR - SHARE (Stations at High Altitude for Research on the Environment) Project

Ev-K2-CNR



EV-K2-CNR research station, Lobuche, Khumbu, Nepal. Photo: Ev-K2-CNR

The implementation of an environmental monitoring network started in the Himalaya-Karakorum region with the aim of determining meteo-climate parameters, atmospheric chemical measurements, limnological and paleolimnological analysis on high altitude lakes, glaciological monitoring and precise measurement of Earth surface coordinates. This was with the intention to develop an integrated system of measurements to significantly contribute to the improvement of environmental and earth sciences

knowledge in the region; to activate technology transfer and capacity building activities in the environmental and geophysical monitoring field through direct involvement of local communities; and to make local people responsible for the control and the management of their land.

The idea of carrying out research activities in Central Asia around the highest peaks of the world, Everest and K2, has shown an importance and a strategic scientific role in the comprehension of environmental and terrestrial phenomena at local, regional and global levels. In the last decades an increasing annual mean temperature trend has been recognised. Seasonal temperature trends and their spatial distribution highlight also the influence of monsoon circulation which on analysis, revealed a negative precipitation tendency, more evident in western region.

Climate variations make the Himalayan area extremely vulnerable. In the last ten years, temperature increase is producing a moving back of glaciers and snow cover, reducing water resources in the dry season. This aspect makes less reliable an already precarious hydroelectric energy system and influences irrigation and drinking water supply. Glacier melting causes the collection of water in lakes that can break the terminal moraines provoking disastrous sinking and floods named Glacial Lake Outburst Floods (GLOFs). The discharge of water and debris cause dangerous floods.

Ecosystems and mountain ranges are fragile and processes caused by climate variations and decay brought on by improper resources management represent a critical element to take into account in the planning and management of sustainable development in these lands.

Global climate change influences monsoon circulation and precipitation trends in South Asia, where pollution emission is extremely high. These pollutants that in the atmosphere form a thick grey-brown cloud, can considerably reduce solar radiation reaching the Earth surface (up to 15%) causing possible soil cooling, atmospheric heating and influencing human health, agriculture, biodiversity, especially in mountains regions.

Further to the importance of the collection of scientific information, Ev-K2-CNR has foreseen their utilisation in an international partnership initiative planned and promoted by the Ev-K2-CNR Committee. This project, funded by the Italian Government, foresees the implementation of a mechanism supporting mountain development in the Hindu Kush - Karakorum - Himalaya, using a data base of bio-physical and socioeconomic data, considered as a priority aspect in poverty reduction and environmental conservation. Such a system includes software applications based on data and predictive models and will establish a Decision Support System (DSS) for reaching of one of the main targets of the Millennium Development Goals. This initiative has been formally presented by the Italian Government and approved by the United Nations Secretariat as a partnership initiative-Type II- during the WSSD in Johannesburg (2002).

#### Monitoring stations

The present operational sites are listed in the above table:

The "Ottavio Vittori" Research Station is a GAW-WMO regional station that is performing research and measurements of greenhouse gases, trace gases, natural radioactivity, aerosol, bioaerosol (spores and pollens), total NO<sub>2</sub> and O<sub>3</sub>, NO<sub>2</sub>, vertical

Installation site	Nation/Continent		Station	Characteristics	Altitude (m. a.s.l.)
Mt. Cimone	Italy	Europe	"Ottavio Vittori" Research Station	Atmospheric monitoring station	2,165
Pyramid Laboratory Observatory (Lobuche)	Nepal	Asia	Nepal Climate Observatory-Pyramid (ABC-Pyramid)	Atmospheric monitoring station	5,079
			GPS Master	GPS station	5,050
			AWS 0, AWS 1, AWS CEOP	Automatic weather stations	5,050
			DORIS	Orbitographic station	5,050
Pheriche (Khumbu Valley)	Nepal	Asia	AWS 2	Automatic weather station	4,258
Namche Bazar (Sagarmatha National Park Head Quarter, Khumbu Valley)	Nepal	Asia	AWS NP	Automatic weather station	3,560
Lukla (Khumbu Valley)	Nepal	Asia	AWS 3	Automatic weather station	2,660
Urdukas (Baltoro glacier, Baltistan)	Pakistan	Asia	AWS PK1	Automatic weather station	3,926
Askole (Baltistan, Pakistan)	Pakistan	Asia	AWS PK2	Automatic weather station	3,015

profile solar photometry, cosmic radiation, meteorological parameters. The Himalaya-Karakorum environmental monitoring network is carrying out continuous measurement.

The NCO-P laboratory transmits real time data to Italy through a satellite connection. Importance and representativeness of collected data has allowed the inclusion of these stations in important international programs and particularly in the CEOP Project (Coordinated Enhanced Observing Period, now Coordinated Energy and Water Cycle Observation Project) for meteorological data collected in Nepal and Pakistan and the ABC Project (Atmospheric Brown Clouds) for the atmospheric monitoring station NCO-P. For the last ten years, glaciers and lakes are annually monitored. In particular lakes 'Inferiore' and 'Superiore' located near the Pyramid are part of ILTER (International Long Term Ecological Research - Network).

### Project development

Contemporaneously to the development of the projects in Asia and Europe, Ev-K2-CNR activities are directed to promote research in mountain environments at a global level to contribute to the amelioration of Earth conditions. For this reason and because of the importance and the fragility of these ecosystems and their influence on global processes, data collected in these areas is unique.

The main activities foreseen for the new phase of SHARE will be to:

- Improve the monitoring network in the Himalayas and Karakorum through additional installations;
- Expand measurement area to other mountain ranges where there are no ongoing research activities.

In the Himalayan area, the installation of seismic stations is planned to measure tectonic movements in the area and a

hydrometer to analyse catchment inflow in the Sagarmatha National Park area, while in Karakorum, near the Baltoro area, an atmospheric monitoring station will be installed.

The first measurements in Africa have started in June 2006 to obtain information on one of the main glacial system of this continent. A weather station has been installed in Uganda, in the Rwenzori mountains near the Elena Glacier, at 4,700 m.

With the increase in research activities, collected data could, as it has already been done, contribute even more to the international projects that are analysing problems related to global changes.

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## Member Initiatives

### Adaptation to Climate Change: Biodiversity and Sustainable Livelihoods at Lake Fúquene, Colombia

Fundación Humedales



Fisherman, Colombia. Photo: Fundación Humedales

High Andean ecosystems were identified by the Colombian Government as the most vulnerable to Climate Change. These include páramo, which are a high Andean moorland-type of ecosystem rich in endemic biodiversity, distributed in an archipelago pattern. Vulnerability to rising temperatures is extremely high in páramo, where upward shift of life zones makes adaptation virtual impossible and massive extinctions are expected to occur. Scenarios for adapting to change need to be considered within the framework of páramo environmental planning, including action for saving the remaining biodiversity, managing new emerging ecosystems, dealing with disrupted human livelihoods and compensating for water losses in downstream watersheds.

Adaptive management scenarios, with actions directed to maintain an ecosystem within the range of conditions that determine its desired state, are most likely to occur in aquatic mountain ecosystems. The relative higher resilience of highland wetlands to human stresses and the obvious need to maintain the water supply, makes these systems attractive to decision makers and local communities. However, the exclusive focus on water as a resource and the relative neglect of biodiversity and human livelihoods in management schemes makes these ecosystems vulnerable to change.

Foundation Humedales, a national environmental NGO created to promote sustainable community based management of wetland and inland water ecosystems, since 2000 has been promoting an ecosystem-based approach for the management of Lake Fúquene (3,155.79 ha) and its related Cucunubá (213 ha) and Palacio (73.5 ha) wetland complexes, which are the largest remnant wetlands of the high Eastern Cordillera Bogotá plateau (2,500 m altitude). These lakes and wetlands harbour the healthiest global population of a handful of bird and fish species and represent of the last resorts of a human habitat once widespread across the cordillera. Environmental services are also represented by water for human consumption and recreational and cultural values.

During the 20th century extensive drainage occurred and a dairy industry was developed. Water inflow decreased by 47 %, water levels decreased by 2m and the surface of the lake was reduced to 3,300 ha, exacerbating the problem. An environmental crisis has been developing from the mid eighties. The extinction of the Andean grebe *Podiceps andinus* in the area by the mid 50s represented the tip of the iceberg of a biodiversity loss disaster occurring in the lake. Traditional livelihoods are being threatened by poverty. Particularly affected are the hundreds of families who strive for subsistence from the lake's dwindling biological resources. The response of the authorities has been limited to corrective measures centred on the functioning of irrigation for maintaining the wealthy dairy industry, with the risk of further exacerbating the situation. Current policy options for the area have been formulated, so as to improve the hydrological regulation of the watershed.

Based upon the review of impacts of climate change and field information, a general assessment of vulnerability of the ecological and social system is being carried out. A strategy of adaptation is being devised as part of a policy-making process in which Fundación Humedales is actively taking part, represented by nomination from local communities and NGOs. A conceptual model linking climatic, hydrological, ecological and social variables (region, watershed, wetland complex and site) has been devised for the social and ecological system.

The Lake Fúquene complex has a climate ranging between semi-arid and cold humid with a bimodal rainfall pattern. Multi-annual patterns of rain, flow and water levels in the lake are associated with the alternation of dry (El Niño) and humid periods (La Niña), generating a highly fluctuating hydrological regime. Climate change models depict a scenario of additional tensors (temperature increases between 2.5-3 °C and decreases in precipitation between 10 - 20%, have led to an upward shift of 500m in altitude in life zones, with potential devastating effects.

An adaptive scenario incorporates the improvement of the resilience of the ecological system, by means of:

- > defining the ecological flow;
- > a recovery of water inflows into the lagoon from 2.08 m<sup>3</sup> / sec to 3 m<sup>3</sup>/sec;
- > the construction of a flood gate making the management of irrigation independent of the lagoon;



Santiago Valderama, Colombia. Photo: Fundación Humedales

- the regulation of the water level to make it one metre higher;
- the improvement of water quality; and
- the rehabilitation of the hydrological connectivity.

Actions to improve social resilience include:

- legal protection;
- incorporation of biodiversity conservation;
- improvement to economic revenues from the uses of biological resources (fish, reeds, bio-manure and ecotourism); and
- the consolidation of two local associations through a participatory monitoring program.

Uncertainty persists in the face of climate change and uncertain policy scenarios. Models integrating climate, hydrology, ecosystem structure and functional biodiversity with ecosystem services and local community's livelihoods are required in more detail and scope. Current actions should be integrated within an ecosystem-based management plan and a protected area that allows for direct use of natural resources combining active habitat management, that will bring legal stability for the human-lake conservation process. Further efforts are needed in order to correct the inequitable distribution in society of the costs and benefits generated by the current management. The achieved integration of local and ONG actions with the international Living Lakes network and the World Conservation Union, have brought scenarios for sharing and enhancing experiences in the lake, which is being proposed to be included in the list of wetlands of international importance (Ramsar).

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Fundación Humedales (<http://www.fundacionhumedales.org>) is a project funded by Alcoa Foundation and supported by World Wildlife Fund (USA). The Fundación is a member of the World Conservation Union IUCN and Living Lakes International Network and is currently acting as an advisor to the Colombian government for the sustainable management of the lake ecosystem.

### Andean Solar Villages – Project Note

Yolanda Ortiz



Cooking with Solar cooker. Photo: Yolanda Ortiz

Collected fire wood is the principal source of energy in most of the Andean villages in the Argentine-Chile-Bolivia triangle. Increasing energy demands of the local population are leading to progressive and accelerated desertification in this semi-arid mountain region. This high plateau called Altiplano or Puna represents a highly vulnerable ecosystem that is essentially endangered by this development. It takes the widespread Tola scrubs several decades to grow to their full height of maybe 1.5 m. Uprooting them for firewood is common practice. Using Tola as fire-wood thus means burning scarce biomass resources and thus destroying valuable carbon sinks. The thinned out soil offers wind and water a big contact surface for erosion. Further desertification of the Puna could end up in total collapse of the ecosystem.

To present a suitable alternative for cooking, Fundación EcoAndina based in Salta in Argentina successfully introduced parabolic solar cookers in the region as one part of the broader Andean Solar Villages concept. The latter, being an integral concept, comprises not only multiple types of thermal energy to meet the demands of the local population, especially heating of buildings and water, but also tries to re-cultivate old Inca terraces by applying PV powered drip irrigation systems.

In the first step of the proposed project activity, only the solar cooker component of the Andean Solar Villages concept is being linked to the carbon market to allow for wider dissemination of this adapted solar technology in the region. All prior pilot projects were financially dependent on donations and subsidies, as solar cookers are not affordable by the local indigenous population.

#### Project activity, location and technology

The project consists of the implementation and application of 50 solar cookers by private users in several villages in the Argentinean Puna around the village of Misa Rumi, located in the North-Western Argentinean province of Jujuy.

Using these cookers, the local villagers will shift away from the unsustainable use of biomass. They will save a lot of time by not collecting wood and the local ecosystem will be protected. Above all, carbon emissions from wood combustion will be prevented.

# Member Initiatives

The solar cookers are purchased by local villagers based on the expectation the villagers will be repaid by a kind of bonus of 20-50 Euros per year, depending on the individual use intensity of the cookers, so carbon credits will be directly distributed to the users. With this, the solar cookers will be affordable.

The amount of cooker use will be measured individually for every cooker. This is accomplished by SolCoDat, an innovative monitoring device. This marks a great step forward for projects that have many and widespread users, which have been depending so far on imprecise monitoring methods like random sampling etc.

## GHG Mitigation potential

Baseline calculations are based on the assumption that a suppressed demand for LPG cookers exists. This corresponds to the official draft baseline and monitoring methodology AMS-I.E as proposed by the Small Scale Working Group assisting the CDM Executive Board of the UNFCCC. It is also consistent with the common observation that the few wealthier households in the Puna use LPG for cooking and sometimes also heating.

We expect an average of some 2.5 tonnes of CO<sub>2</sub> emissions to be avoided annually by each cooker, resulting in about 125 tonnes of CO<sub>2</sub> emissions annually for the whole project. As for lifetime of the project, we expect the cookers to be used for at least 5-10 years.

## Sustainability

The proposed project activity contributes to sustainable development in manifold ways, one of which is of course the mitigation of GHG emissions as described above. In a broader ecological sense, the protection of the Puna as a whole should be mentioned here. This project can serve as a demonstration of the suitability and marketability of adapted solar technology. Its further dissemination could contribute to the prevention of further dissemination of LPG use or even of large and ecologically dangerous projects like building a natural gas pipeline to the Puna for the purpose of serving people's thermal energy needs. The quality of life of the local population is significantly improved, as long-distance walks with heavy loads of fire wood carried on the back will be avoided particularly for women and children who usually do this work. Children will be able to use the saved time for playing and studying.

As for the technology, the solar cookers have been shown to be very well accepted by local people. Their proper operation and care is assured through intense and adequate user training. The technology is simple and solid, easy to repair and well proven in the region.

## Project participants

The project was designed and will be coordinated by Fundación EcoAndina, an experienced Argentinean NGO that has been developing the Solar Andean Villages concept for more than ten years and has successfully implemented several pilot projects in the area. Consulting and development is undertaken by enveco GmbH from Münster in Germany.

The cookers are manufactured by PIRCA in Tilcara, Argentina, an indigenous cooperative with long-term experience in adapted solar technology. The Argentinean NGO CAMBIAR (Centro Ambiental Argentino) concerns itself with institutional contacts and promotion to foster dissemination and a broader acceptance of the Andean Solar Villages concept by the public as well as in the relevant administration levels and units.

## Project Status

Currently, 40 orders have been accepted for solar cookers from the villages of Lagunillas de Farallon, Rinconada, Paicone, Cienaga, Oros and Cabreria. These are being produced by the PIRCA factory in Tilcara.

It is expected that 50 cookers will be sold by October 2007. Delivery and installation of the cookers, as well as user training should be completed by November 2007. The first payments to the users are planned to be made around March 2008 when the monitoring devices will be read for the first time. Data read-outs shall be initially performed by Fundación EcoAndina and will then be handed over to a local villager to minimise the need to travel. The PDD is currently being developed by enveco GmbH, using the above mentioned baseline and monitoring methodology AMS-I.E.

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Centro Ambiental Argentino (CAMBIAR) or "TO CHANGE" works with other mountain organisations as well as the Universities of Tucumán and Catamarca, to promote the quality of life and equality of opportunities in this region of the Argentinian northwest (NOA). In particular, work is being done in Tucumán in the valleys with small producers with the objective to preserve Andean culture and traditions of the indigenous peoples to behave as custodians of nature.

### Environmental Awareness Among Children and People

*Global Mass Community Welfare Organisation*

Innovative approaches to environmental education are the best way to raise environmental awareness among children, villagers and those living near forest and mountain areas. We need to help children become friendlier towards nature, the environment and climate change.

With this in mind, Global Mass Community Welfare Organization (GMCWO) plans to conduct a key project on "Children's Environmental Awareness" to help children and people identify environmental issues in their surroundings and develop possible solutions for the problems.

An important aspect of the project is to sensitise teachers to the gravity of environmental issues and to use the issues as a means to take up activities with children.

There is a dire need for environmental awareness among children and villagers. The methodology adopted by the Global Mass Community Welfare Organization is to arrange and provide interesting, relevant and appropriate information related to the major environmental concerns in the mountain area of Azad Jammu & Kashmir region through multimedia projectors, laptop computers, lectures, poster competitions and various drama performances related to environmental threats, their causes and their remedies. GMCWO conducted formal meetings with teachers to give them the direction for a plan of action and informal meetings with children to assess the impact of awareness created among them.

To expand the scope of the project, GMCWO compared and evaluated the level of understanding developed among the children with that of children in other schools. The result was positive among the children as well as the teachers and people, toward the creation of environmental awareness and understanding of their surroundings.

Further, GMCWO has prepared an attractive Microsoft Power Point slide presentation following the environmental chapters in the science syllabus books from the 6th to 10th classes. The effort also played a part in creating an overall understanding of hygiene and sanitation conditions prevailing in the village and how each one of the children and villagers can contribute towards improving the prevailing conditions and environment in the village.

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Global Mass Community ([gmcak.tripod.com](http://gmcak.tripod.com)) is an independent non-profit global campaigning organisation that uses non-violent, creative confrontation to expose global environmental problems and their causes.

### Mitigation of Climate Change in the Western Himalayas

*Pragya*



*Snow fences in Lahaul Valley, Indian Himalaya. Photo: Pragya*

Pragya is an Indian NGO based in Delhi. The organisation specialises in working in high altitude areas of the Indian Himalayas (above 8,000 ft), and is the only NGO to have a presence in every Indian Himalayan state. Pragya is currently implementing a project called Water Access and Wasteland Development in the Western Himalayas, which combines natural resource management strategies and infusion of appropriate technology, along with social mobilisation, to mitigate the growing problems of water and ecosystem stress in this region.

Water has never been an abundant resource in the Western Himalayas. Despite the vast reserves stored in snow and glaciers amongst the peaks, which are the ultimate source of the great rivers which water the Punjab, the Western Himalayan valleys receive minimal rainfall, and nearly all their water comes from glaciers and snowmelt. The Intergovernmental Panel on Climate Change (IPCC) has predicted that the pattern of climate change could be up to three to five times higher in high altitude areas than lowlands, which suggests that the Himalayas are likely to experience large temperature rises - large enough to greatly reduce the size of, or melt completely, most of the glaciers and mountain snow from which the Western Himalayan valleys receive their water.

The well-known fact that glaciers in the region have significantly shrunk over recent decades has not reduced the overall amount of water available as yet, but changes in the patterns of precipitation throughout the year mean that snow tends to melt more quickly in the spring and early summer, leaving a reduced flow of rivers and springs later in the summer, which is the growing season. The increasingly erratic and unpredictable precipitation patterns, added to the reduction of meltwater which will no doubt eventually occur once the glaciers are exhausted, make the careful and sustainable management of water resources vital for the future of Western Himalayan communities.

The Water Access and Wasteland Development Project is concerned with both the supply and the uses of water, and it aims to develop procedures for integrated water management at a watershed level.

## Member Initiatives

The springs from which villages traditionally drew their water, many of which have begun to dwindle in recent years, are being rejuvenated by techniques such as afforesting the slopes above the outlet with native trees, shrubs and herbs, and installation of harvesting technologies such as snow pits, snow fences and check walls still higher up. All of these measures reduce water runoff when the snow melts in spring, and promote absorption of water into the soil. Snow harvesting techniques are also being used at many sites which a few years ago were suitable for crops, but due to the increasing scarcity of water have become parched wasteland and scrub. By increasing the moisture content of the soil these lands can become suitable for growing high value cash crops such as medicinal plants, which, being mostly perennial, bind the soil and reduce surface runoff, and can significantly increase the incomes of marginal farmers.

The project is also catalysing the development of norms and processes for careful use and equitable distribution of water in households and villages, and also between villages which share the same water source. This includes establishing community-based institutions to oversee the implementation of these procedures, and settle disputes (the number of which have been growing in recent years, as resources diminish) by consensus. Apart from water, these institutions will also have a role in managing other common property resources (CPRs) such as forests and rangelands. In these fragile ecosystems the cultivated sphere is closely linked to the "wild", which itself plays a vital role in sustaining the livelihoods of local people. The growing number of disputes regarding woodcutting and grazing rights in recent years show to what extent the CPRs are also becoming degraded, and how serious the consequences of this are for populations who depend on them.

With droughts already common and expected to increase, the project is also setting up seed banks and local credit systems to help farmers recover after the drought period is over. These measures are important firstly because they will reduce the hardship of individual farmers and their families in difficult times, but also on a broader level because they will prevent the ruin of farmers which would cause mass exodus from the

region and abandonment of the land, a cycle of further land degradation and more impoverishment.

As climate change progresses, holding on in regions which have always been marginal becomes increasingly difficult: our challenge will be to develop ways of facing these problems to ensure the future prosperity of mountain communities.

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Tom Owen-Smith is a member of Pragma's Research, Advocacy & Fundraising Team. He can be reached at [tomowensmith@pragya.org](mailto:tomowensmith@pragya.org).

Pragya is a non governmental development organisation working with the indigenous communities in the Indian Himalayas since 1995. Pragma interventions are addressing different need areas of these communities, and involve both research and implementation projects. Projects address issues of biodiversity conservation, traditional knowledge preservation, empowerment of indigenous communities and marginalised groups, infusion of appropriate technologies including renewable energies and microenterprise development. To find out more about Pragma's projects, please visit <http://www.pragya.org>.

## IUCN-Med Workshop, December 2007 - Mediterranean Mountains in a Changing World

IUCN-Med



Mixed forest, Middle Atlas. Photo: Pedro Regato, IUCN/WWF.

At the World Conservation Congress held in Bangkok in November 2004, the IUCN members approved the resolution 3.039 "The Mediterranean Mountains Partnership", calling all concerned national, regional and local institutions to develop action plans for each of the major mountain ranges in the region, with the aim of achieving the conservation of their biological, landscape and cultural diversity and boosting sustainable development. IUCN members expressed the wish that these action plans should be recognised as a political and institutional basis for cooperation at national and trans-national levels.

The IUCN Centre for Mediterranean Cooperation (IUCN-Med) through the support of the Italian Ministry of Environment, has taken the task to facilitate the implementation of resolution 3.039 through a consultation process with regional organisations and experts who are active in conservation and development of Mediterranean mountain systems. The final objective of this exercise is to reach an agreement on strategic guidelines for the development of Mediterranean Mountains Action Plans.

On 10-12 December 2007, IUCN-Med has thus brought together Mediterranean member organisations and experts in a regional workshop at its headquarters in Málaga on conservation and development challenges for Mediterranean Mountains. The workshop coincided with the UN designated "International Mountain Day" on 11th December, as a good opportunity to raise public awareness about the opportunities and constraints in Mediterranean mountain conservation and development in a changing world. A field day was organised in the "Sierra de las Nieves" Natural park and Biosphere Reserve, as an opportunity to raise awareness about the recently created Trans-continental Biosphere Reserve involving key mountain hotspots for biodiversity around the Strait between Spain and Morocco.

IUCN-Med has been preparing a draft working document on key conservation and development issues for the Mediterranean mountains, which served as a blueprint to introduce themes and guide discussions during the workshop. The priority themes identified were:

- ▶ The Ecosystem Approach in Mediterranean mountains conservation and development;

- The in-situ preservation and improvement of environmental services and landscape values;
- The Mediterranean mountains identities and traditional knowledge of their inhabitants;
- Participatory and governance mechanisms in conservation and development of Mediterranean mountain resources;
- The role of mountain communities in conservation and development;
- Innovative mechanisms and policy incentives for investing in Mediterranean mountain resources and reduce handicaps;
- Opportunities for mitigating environmental risks and global change impacts in the Mediterranean mountains;
- Specific institutional and/or legal frameworks for Mediterranean mountain conservation and development;
- The added value of cooperation with other Country/Mediterranean-wide/World-wide mountain initiatives.

In order to facilitate working groups' discussions, IUCN identified a number of successful practices, which were used as case studies during the workshop. Around 30 regional experts from research institutions (Universities and international research centres), intergovernmental (i.e. FAO, Blue Plan, UNEP, UNDP) and governmental organisations and national and regional NGOs have met and discussed about key conservation and development issues and opportunities for developing Mediterranean mountains action plans.

The conclusions and recommendations of the workshop are now being collected into a final document on "Guidelines for the elaboration of action plans for the Mediterranean mountain chains", that IUCN-Med will disseminate among partner organisations.

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IUCN-Med (<http://www.iucn.org/places/medoffice/>) has more than 170 members in the Mediterranean region including most states bordering the Mediterranean Sea (including Andorra, Jordan and Portugal), government bodies and NGOs of national or international scope. The centre's priorities are biodiversity conservation and the sustainable use of natural resources.

### Partnerships in Action in the HKKH Region

*HKKH Partnership*



*Mount Everest, Nepal-China. Photo: Marianne Heredige*

The HKKH Partnership Project is a regional initiative aimed at consolidating institutional capacity for systemic planning and management of socio-ecosystems in the Hindu Kush-Karakoram-Himalaya mountain complex. The project, supported by the Italian Cooperation, is implemented by IUCN in partnership with ICIMOD, CESVI and Ev-K2-CNR. The project was presented by Italy and approved by UN as a Type II outcome of the World Summit on Sustainable Development (WSSD) and is part of the Mountain Partnership.

This multi scale initiative is active at regional, national and local levels with a special focus on three protected areas: Sagarmatha (Everest) National Park (SNP) in Nepal, Central Karakoram National Park (CKNP) in Pakistan and Qomolangma Nature Preserve (QNP) in Tibet Autonomous Region of China. Currently, activities have started in Nepal and Pakistan while they are planned to begin in China.

While the overall scope and approach of the project were presented in the last issue of the Mountain Forum Bulletin, this article will highlight selected activities.

#### **Exploring the future: modeling for the management of Sagarmatha (Everest) National Park, Nepal**

This will be a record year for tourism in SNP: the total number of visitors is the highest ever registered. While this is good news for the economic development of the region, the potentially negative impacts have to be identified in a timely way and appropriate management interventions put in place. This is even more important at a time when climate change could affect the fragile ecosystem of Mount Everest. The project is mobilising a wide partnership to develop research and modeling: the Department of National Park and Wildlife Conservation, the Park Management and Buffer Zone Council, the Sagarmatha Pollution Control Committee, Resource Himalaya, Tribhuvan and Kathmandu Universities in Nepal, Universities of Padova, Rome, Bologna and Naples in Italy, Simulistics Inc. in the UK. Partners are joining hands to develop a socio-ecosystem model

## Member Initiatives



Northern Areas, Pakistan mission. Photo: Emanuele Cuccillato, HKKH Partnership

for exploring future trends, analysing resilience and testing management options. This collaborative modeling approach is innovative and constitutes a pilot experience in a region where tools to analyse impacts and support adaptation to rapid change are in great need.

### **Forging partnerships for the Central Karakorum National Park, Pakistan**

During the past months, substantial progress has been achieved in the development of CKNP, a park of stunning beauty encompassing K2, the Baltoro glacier - the biggest outside the poles - and several other gems. Thanks to the commitment of the Northern Areas Government and the support of the HKKH Partnership, Karakorum Trust and WWF a project for the establishment of the park has been recently approved. The HKKH Partnership has organised a first exercise to explore the future of the area using Scenario Planning. Several preliminary assessments have been carried out to develop research and baseline studies on wildlife, glaciology, biodiversity, forestry and livelihoods. A series of workshops has been organised to develop a common management planning process and build partnerships for research. The Karakorum International University, where some events were hosted, is emerging as a key actor capable of catalysing long term research in the region.

Sharing data and information is indispensable for the management of a mountain complex that spans over eight countries. Workshops introducing the FAO/UNEP standard Land Cover Classification System have been organised in Nepal and Pakistan in collaboration with the FAO Global Land Cover Network (GLCN) program. Regional training on GIS applications for protected area management has further contributed to enhancement of capacities and building of transboundary networks; this action will be continued in the next months with regional, national and local level activities focused on metadata management, GIS applications and land cover mapping.

### **HKKH working paper series launched**

On the occasion of the 4th IUCN Regional Conservation Forum, the Project launched the HKKH Working Paper Series. With the objective of sharing the project's experience and stimulate debate, key technical documents have been published on the

project web portal <http://www.hkkhpartnership.org>. Visit the portal to know more about the project and gain access to resources as the project knowledge base, interactive maps and the discussion groups that will be launched soon.

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Emanuele Cuccillato, The World Conservation Union (IUCN), is the Chief Technical Advisor for the HKKH Partnership Project and can be reached at [Emanuele@iucn.org.np](mailto:Emanuele@iucn.org.np).

The upcoming events listed below were brought to our attention by Mountain Forum members as well as event organisers. If you have information on a mountain related event, please send the information to the Mountain Calendar via the submittal form at: <http://www.mountainpartnership.org/events/c-newevent.asp>

For many of these events, more detailed descriptions are available on the Mountain Partnership website: <http://www.mountainpartnership.org/events/default.asp>. Many thanks to all the contributors for sharing this information with the Mountain Forum community.

Mountain forum is not responsible for any changes in the programmes. Please contact the event organisers for the latest information.

## January

### 4-30 January 2008

EC Project Development - Energy & Environment  
Budapest, Hungary  
Web: [http://www.eutrainingsite.com/open\\_details.php?id=25](http://www.eutrainingsite.com/open_details.php?id=25)

### 7-9 January 2008

International Workshop on Snow, Ice, Glacier and Avalanches  
Mumbai, India  
Email: [workshop@csre.iitb.ac.in](mailto:workshop@csre.iitb.ac.in)  
Web: <http://www.csre.iitb.ac.in/csreworkshop/index.html>

## February

### 9-10 February 2008

Himalaya Film Festival 2008  
Netherlands  
Contact: [info@himalaya-archief.nl](mailto:info@himalaya-archief.nl)  
Web: <http://www.himalayafilmfestival.nl>

### 11-13 February 2008

5th EARSeL Workshop: Remote Sensing of Land Ice and Snow:  
Changing Climate - Changing Cryosphere  
University of Bern, Switzerland  
Contact: [swun@giub.unibe.ch](mailto:swun@giub.unibe.ch)  
Web: <http://www.geography.unibe.ch/research/remotesensing.html>

### 11-15 February 2008

Workshop on Mountain Mapping and Visualisation  
Lenk, Switzerland  
Contact: [lenk2008@cartography.ch](mailto:lenk2008@cartography.ch)  
Web: <http://tinyurl.com/2m82al>

## March

### 31 March-22 April 2008

ICIMOD's Second International Training Course on Low Cost Soil and Water Conservation Techniques and Watershed Management Activities  
Kathmandu, Nepal  
Deadline for registration: 7 March 2008  
Contact: [Keshar Sthapit at ksthapit@icimod.org](mailto:Keshar Sthapit at ksthapit@icimod.org)  
Web: [http://www.icimod.org/webcalendar/view\\_entry.php?id=560&date=20080331](http://www.icimod.org/webcalendar/view_entry.php?id=560&date=20080331)

### 26-28 March 2008

Workshop on Rethinking Impact: Capturing the Complexity of Poverty and Change  
Cali, Colombia  
Contact: [prga@cgiar.org](mailto:prga@cgiar.org)  
Web: [http://www.mountainpartnership.org/events\\_input/default.asp](http://www.mountainpartnership.org/events_input/default.asp)

### 26- 28 March 2008

International workshop on glacier mass balance measurements and modelling  
Skeikampen, Norway  
Contact: [lma@nve.no](mailto:lma@nve.no)  
Web: [http://www.nve.no/modules/module\\_109/publisher\\_view\\_product.asp?iEntityId=10452](http://www.nve.no/modules/module_109/publisher_view_product.asp?iEntityId=10452)

## April

### 1-4 April 2008

International Symposium: Interdependencies between upland and lowland agriculture and resource management (Uplands 2008)  
Stuttgart, Germany  
Contact: [uplands2008@uni-hohenheim.de](mailto:uplands2008@uni-hohenheim.de)  
Web: <http://www.uni-hohenheim.de/uplands2008>

### 2-4 April 2008

International Conference: Mountain Forests in a Changing World  
Austria  
Contact: [mountainforestry@boku.ac.at](mailto:mountainforestry@boku.ac.at)  
Web: <http://mountainforestry.boku.ac.at>

### 7-9 April 2008

COST strategic conference: Global change and sustainable development in mountain regions  
Innsbruck, Austria  
Contact: [amossele@nrca.gc.ca](mailto:amossele@nrca.gc.ca)  
Web: <http://bfw.ac.at/rz/bfwcms.web?dok=6202>

## May

### 5-16 May 2008

16th session of the Commission on Sustainable Development (CSD-16)  
New York, USA  
Web: [http://www.un.org/esa/sustdev/partnerships/partnerships\\_whatsnew.htm](http://www.un.org/esa/sustdev/partnerships/partnerships_whatsnew.htm)

### 8-13 May 2008

Conference on Parks and Protected Areas  
Alberta, Canada  
Contact: [abstracts@parks4tomorrow.ucalgary.ca](mailto:abstracts@parks4tomorrow.ucalgary.ca)  
Web: <http://www.parks4tomorrow.ucalgary.ca/>

### 12- 17 May 2008

3rd International Workshop on Ice Caves IWIC-II  
Kungur Ice Cave, Perm region, Russia  
Contact : [IWIC\\_III@unimi.it](mailto:IWIC_III@unimi.it)  
Web: <http://users.unimi.it/icecaves/IWIC-III/>

### 13-16 May 2008

World Environmental & Water Resources Congress 2008: Sustainability from the Mountains to the Sea  
Honolulu, Hawaii, USA  
Contact: [ssingleton@asce.org](mailto:ssingleton@asce.org)  
Web: <http://content.asce.org/conferences/ewri2008/>



# Mountain Calendar 2008

## 14 -16 May 2008

International conference on school safety  
Islamabad, Pakistan  
Contact: [akpbsp.k@akpbsp.org](mailto:akpbsp.k@akpbsp.org)  
Web: <http://www.akpbsp.org>

## 15-19 May 2008

Understanding and Managing Amenity-led Migration in Mountain Regions  
Banff, Canada  
Contact: [amy\\_krause@banffcentre.ca](mailto:amy_krause@banffcentre.ca)  
Web: <http://www.banffcentre.ca/mountainculture/mtnconferences/am/>

## June

### 2 June - 29 August 2008

IIASA Young Scientists Summer Program 2008  
Laxenburg, Austria  
Contact: [Ysspsupport@iiasa.ac.at](mailto:Ysspsupport@iiasa.ac.at)  
Web: [http://www.iiasa.ac.at/Admin/YSJP/reg-info/more\\_about\\_the\\_program.html](http://www.iiasa.ac.at/Admin/YSJP/reg-info/more_about_the_program.html)

### 5 June 2008

Kick the Habit-World Environment Day 2008  
Wellington, New Zealand  
Contact: [nick.nuttall@unep.org](mailto:nick.nuttall@unep.org), [joelle.mojon@unep.org](mailto:joelle.mojon@unep.org)  
Web: <http://www.unep.org/wed/2008>

### 9-12 June 2008

MTNCLIM 2008 Mountain Climate Research Conference  
Silverton, Colorado, USA  
Contact: [cmillar@fs.fed.us](mailto:cmillar@fs.fed.us)  
Web: <http://www.fs.fed.us/psw/mtnclim/>

### 9 - 13 June 2008

International Symposium on Radioglaciology and its Applications  
Madrid, Spain  
Contact: [igsoc@igsoc.org](mailto:igsoc@igsoc.org)  
Web: <http://www.igsoc.org/symposia/>  
<http://sympradar08.krios-hyperion.com/>

### 18-21 June 2008

Landscape Evolution & Geoarchaeology: 13th Belgium-France-Italy-Romania Geomorphological Meeting  
Porto Heli, Greece  
Web: <http://www.geoarch2008.gr/>

## August

### 17 - 22 August 2008

International Symposium on Dynamics in Glaciology  
Limerick, Ireland  
Contact: [igsoc@igsoc.org](mailto:igsoc@igsoc.org)  
Web: <http://www.igsoc.org/>

### 25-29 August 2008

International Symposium: the role of geomorphology in environment management  
Yogyakarta, Indonesia  
Web: <http://www.geomorph.org/sp/arch/IntSymIND2008-1.pdf>

## Please update your contact information!

Dear Mountain Forum member,  
Please update your contact information by visiting <http://www.mtnforum.org/mem/update.cfm> or by notifying the regional office nearest to you.

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Email: [namf@mtnforum.org](mailto:namf@mtnforum.org)  
Web: <http://www.mtnforum.org/rn/namf.cfm>



## Supporting Institutions



Food and Agriculture Organization of the United Nations



Swiss Agency for Development and Cooperation



Lake Tilicho, Nepal. Photo: Agustina Barros

## Host Institutions and Partners



African Highlands Initiative



Bellanet



Consortio para el Desarrollo Sostenible de la Ecorregión Andina



European Mountain Forum



Fundació Territori i Paisatge



International Centre for Integrated Mountain Development



International Potato Center



Mountain Research and Development



The Banff Centre



The Mountain Institute



World Agroforestry Centre (ICRAF)



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