Exploring the third pole

Welcome to thethirdpole.net reader

Exploring the third pole
Editor's note

Welcome to thethirdpole.net reader

Since its launch in 2009, thethirdpole.net has provided a unique platform for information, reporting and discussion on the ecology, environment and climate of the Hindu Kush-Himalayas, the Qinghai-Tibet Plateau and the rivers that originate there. We aim to facilitate the free flow of accurate information and analysis and thereby support well informed policymaking in this region. Good governance is crucial to protecting ecosystems on which around 1.3 billion people depend directly or indirectly for their food, water and other vital services.

Using thethirdpole.net's unique reach across the region, we have been able to publish articles by journalists and experts from the various countries that share the benefits and risks of the world's highest mountain range and plateau, from Tibet to Bangladesh. Recognising the continued and pressing need for a regional perspective in a part of the world where access to accurate information is problematic, we are launching the first of a series of thethirdpole.net readers. These special publications will offer invaluable background material to policymakers, academics and other stakeholders.

Important articles are classified by theme and this reader is free to download. We hope that you find it useful and we encourage you to circulate the link. Please also help us to improve and develop this resource by sending your comments and feedback to joydeep.gupta@thethirdpole.net or beth.walker@thethirdpole.net.

Isabel Hilton and thethirdpole.net editorial team

June, 2012

Cover image by Preston Rhea

Exploring the third pole
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Part 1: Why the third pole matters

The region that encompasses the Himalaya-Hindu Kush mountain range and the Tibetan Plateau is widely known as the third pole, because its ice fields contain the largest reserve of fresh water outside the Polar Regions. It is also called the water tower of Asia because it gives birth to 10 major rivers that sustain around two billion people, spread over much of the continent. The region is now under serious threat from climate change, deforestation and ill-planned projects.

In this section, Daniel J Miller explains the global environmental significance of the region. Edward Grumbine and Xu Jianchu warn that climate change may lead to unpredictable and dangerous consequences for water systems, biodiversity and human livelihoods. And Hashi Tashidorjee, through his photos, shows how global warming and economic development are already altering landscapes and lives on the Tibetan Plateau.

Why the third pole matters
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March 05, 2009

Why Tibet matters now

Few places are as globally important as the Tibetan Plateau, writes Daniel J Miller. Understanding this means looking at the region from a holistic, ecological standpoint.

From a global environmental perspective, few places in the world are as important as Tibet. Rising concerns about global warming, climate change, receding glaciers, desertification, food insecurity and loss of biodiversity all point to the significance of Tibet. Tackling these important issues requires greatly increased scientific research in Tibetan areas and improved understanding of current land use practices, especially of agriculture, forestry and livestock grazing. Critical examination of existing environmental conservation and economic development policies and new thinking on how we view the Tibetan landscape are required.

In this article, I use the term "Tibetan Plateau" to refer to a unique geographical area of Asia; a landscape not marked by lines drawn on a map, but defined by topography. It is a region with particular geological, ecological and socio-cultural characteristics. Tackling global environmental challenges in the twenty-first century demands that we view the Tibetan Plateau holistically to understand its unique ecology, its natural resources and illustrious cultural heritage.

Encompassing an area of about 2.5 million square kilometres, or about one-third the area of the continental United States, the Tibetan Plateau is the largest and highest region on Earth. With an average elevation of 4,500 metres above sea level, the Tibetan Plateau stretches for almost 3,000 kilometres from west to east and 1,500 kilometres from south to north. The Plateau is ringed by high mountains – the Himalayas to the south, the Karakorum in the west and the Kunlun across the north. The Tibetan Plateau goes beyond political frontiers and encompasses much of the higher elevation Himalayan regions in Pakistan, India, Nepal and Bhutan as well as all of the Tibetan Autonomous Region, Qinghai, western Sichuan, northern Yunnan, western Gansu and southern Xinjiang Uyghur Autonomous Region in China.

> *Unhindered by the clutter of political boundaries, the land is defined by watersheds, by mountain ranges and large lakes; the natural demarcations of an environment.*

I have a plastic, raised-relief map of China in which the Tibetan Plateau and adjoining mountain ranges stand out clearly. It depicts the vast area encompassed by the plateau and the abrupt uplift of the Himalaya rising from the plains of northern India. Looking at this map you can see how the Tibetan Plateau dominates the geography of Asia.

Photographs taken by astronauts at heights of 200 to 400 kilometres above the earth also provide an out-of-the-ordinary observation of the Tibetan Plateau. Unhindered by the clutter of political boundaries, the land is defined by watersheds, by mountain ranges and large lakes; the natural demarcations of an environment.

These views from space provide a perspective that helps one to think globally and to see the landscape in

its entirety. Environmental conservation strategies for the Tibetan Plateau need to encompass a broad scale and implement programs at the level at which natural systems operate. This landscape level of attention ensures persistence of populations and ecological processes and has to work across political boundaries. Man-made lines on a map do not stop a river from flowing downhill nor do they prevent black-necked cranes from migrating or Tibetan argali and Tibetan wild ass from crossing international borders in search of forage. Birds and animals travel across the earth and we need to adopt a similar style in how we perceive landscapes.

The American poet Gary Snyder wrote, "Now, with insights from the ecological sciences, we know that we must think on a scale of a whole watershed, a natural system. A habitat. To save the life of a single parrot or monkey is truly admirable. But unless the forest is saved, they will all die." Saving the Tibetan Plateau requires an approach that recognises watersheds to define plans of action for conservation and development. It also requires acceptance of the complex nature of the Tibetan landscape, not only in the physical forces that shape it, but also in the interaction of socio-economic and institutional forces that impact the nomads and farmers who use the natural resources.

The Tibetan Plateau plays an important role in global climate change. With its extensive alpine grasslands that store carbon in their plants and soil, the Plateau is a significant carbon pool. The carbon stored in the grassland ecosystem is important to regional and global carbon cycles; it has the potential to modify global carbon cycles and influence climate. What takes place in the Tibetan grasslands therefore should be of increasing importance to a world more and more concerned about climate change.

With thousands of glaciers scattered across the Plateau and the Himalayas, the region has the most snow and ice outside of the polar regions. The glacier-fed rivers originating from the Tibetan Plateau make up the largest river run-off from any single location in the world. With global warming, the total area of glaciers on the Tibetan Plateau is expected to shrink by 80% by the year 2030. The loss of these glaciers will dramatically affect major rivers that provide water for more than one-third of the world's population. The effect of glaciers receding will be felt well beyond the borders of the Tibetan Plateau, with profound impacts over a wide area in Asia and great risks of increased poverty, reduced trade and economic turmoil. This presents major political, environmental and socio-economic challenges in the years ahead.

The Tibetan Plateau forms the headwaters environment where the Yellow, Yangtze, Mekong, Salween, Brahmaputra, Ganges, Sutlej and Indus rivers originate. In addition, rivers from the northern edge of the Tibetan Plateau flow into the Tarim Basin and the Gansu Corridor, providing precious water for the oasis towns along the old Silk Road. The management of these river source environments has global implications, as the water from their watersheds will be of increasing importance in the future. The water they provide is critical to the survival of millions of people downstream. The recent floods in the Indian states of Bihar and Assam draw attention to the critical role of the Tibetan environment in regulating water flow to downstream areas. How many people realise that the Kosi River, which recently flooded and displaced millions of people in the northern Indian state of Bihar, actually has its origins on the north side of Mount Everest? Or that almost 60% of the total length of the 2,906 kilometre-long Brahmaputra River that floods India and Bangladesh every year is located in Tibet? Simply for the water that it provides, the Tibetan Plateau demands greater attention.

Protecting biodiversity on the Tibetan Plateau

A number of biodiversity "hotspots" are located on the Tibetan Plateau. With their highly distinctive species, ecological processes and evolutionary phenomena, these areas are some of the most important areas on earth for conserving biodiversity. The Tibetan Plateau

is one of the most ecologically diverse landscapes on earth. It includes the most intact example of mountain rangelands in Asia with a relatively intact vertebrate fauna, and is one of the largest remaining terrestrial wilderness regions left in the world. The area is home to numerous rare and endangered wildlife species such as the wild yak, Tibetan wild ass, or kiang, the migratory Tibetan antelope, or chiru, Tibetan argali and snow leopard. Conserving these animals and their habitat is an important priority for the global conservation community.

George Schaller, the renowned field biologist who has spent decades working to conserve the wildlife of the Tibetan Plateau and adjoining Himalayan regions, wrote of the vast rangelands of the northern Tibetan landscape, "The beauty of these steppes and peaks will persist, but without wildlife they will be empty and the Tibetans will have lost part of their natural and cultural heritage. To bequeath the Chang Tang [the Tibetan word for the extensive steppes of the northern Tibetan Plateau] far into the next millennium will require a never-ending moral vigilance, a passion to understand the ecology, and a deep commitment to a harmonious coexistence between the nomads with their livestock and the wildlife. Without such dedication there will ultimately be a desert where only howling winds break a deadly silence."

Schaller's exhortation for heightened devotion to conserving the Tibetan ecosystem should be taken as a wake-up call for everyone interested in Tibet.

The Tibetan antelope, perhaps more than any other animal, embodies the expanse of the Chang Tang ecosystem. The chiru is a migratory animal and needs a vast landscape in which to travel between its winter ranges and birthing grounds. They cover distances of up to 400 kilometres, across the steppes and over mountains on their seasonal migrations. In 1994, I attempted to follow the chiru's migration across the Chang Tang, to their birthing grounds on the northern edge of the plateau. Observing herds of hundreds of female chiru, with their female young

of the previous year, travelling on ancient paths as they have for thousands of years is to bear witness to one of the earth's outstanding ecological spectacles. Understanding chiru migratory movements could provide valuable insight into the structure and function of the Tibetan Plateau ecosystem and assist in efforts to protect biodiversity.

> *"The wild yak is an indicator species; its presence reveals a special place – a sacred space. With wild yaks roaming the landscape, an ecosystem is still intact."*

The continuation of Tibetan antelope migration, one of the last great natural marvels on earth, depends on better protection of the species, improved understanding of their ecology and better insights into the dynamics of the Tibetan Plateau ecosystem. It also requires innovative approaches to conservation and pastoral development that adopt participatory, integrated ecosystem management models that work at the landscape level.

If the antelope embodies the expanse, the wild yak characterises the elemental wild nature of the Chang Tang. I made a number of excursions to the Tibetan Plateau to conduct research on wild yaks. Standing almost two metres high at the shoulders, weighing up to a tonne and with horns a metre long, wild yaks are magnificent creatures. The wild yak is an indicator species; its presence reveals a special place – a sacred

space. With wild yaks roaming the landscape, an ecosystem is still intact. If the land can provide habitat for wild yaks, many of the other species of Tibetan wildlife will be there as well.

The wild animal most commonly seen by travelers today in Tibet is the kiang. Galloping across the steppes, their russet and cream-colored bodies contrasting with the golden hue of the grasslands, kiang suggest a sense of unbridled freedom. The remote, northwestern part of the Tibetan Plateau offer notable examples of rangeland ecosystems relatively unchanged by humans and provide the untrammelled space for large herds of kiang to still run wild across the steppes. Wildlife conservation efforts have succeeded in protecting kiang, and their numbers have increased in many areas to the point where nomads now complain that large herds compete with their livestock for grazing.

As a rangeland ecologist, grasses and the interactions between vegetation and the animals – both wild and domestic – interest me. In my numerous journeys on the Tibetan Plateau I have endeavored to understand the ecology of the rangelands. Why are distinctive plant communities found in certain areas? What species of plants dominate these plant communities? What grasses are grazed by livestock? Do wild ungulates eat the same plants? Why are wildlife found in certain locations and not in others? Is there really competition for forage between kiang and livestock? These are questions I asked myself as I walked across the landscape, my eyes trying to pick out patterns on the ground. To the untrained eye that is unable to distinguish one plant from another, Tibetan rangelands, especially in the vast northern steppes, can appear boring and lifeless, particularly when majestic mountains dominate the horizon. But it is the diversity in plant species and mix of plant communities on the rangelands that influences the grazing patterns of livestock and the behaviour of wildlife. And it is this remarkable variation in vegetation on the steppe and the ecological dynamics of the Tibetan Plateau ecosystem that needs to be understood in order to sustain the natural resources for future generations.

Daniel J Miller is a rangeland ecologist and agricultural development specialist with over 15 years professional experience in agricultural development, natural resource management and biodiversity conservation in Asia. He has worked in Bhutan, China, Mongolia, Nepal and Pakistan and has traveled widely throughout South and South-east Asia. He speaks Nepalese, Tibetan and some Chinese.

Images by Daniel J Miller

June 05, 2009

Cascading effects at the third pole

Climate change may lead to unpredictable and dangerous consequences for water systems, biodiversity and human livelihoods across the Himalayas. Ed Grumbine and Xu Jianchu ask how such risks can be addressed.

Published reports about the likely consequences of climate change across the Greater Himalayas (including the Qinghai-Tibetan Plateau) reveal broad agreement that warming in the region will lead to long-term:

- Loss of glacial ice with a corresponding reduction in water availability;
- Increasing incidents of natural disasters such as flooding and glacial lake outburst floods;
- Greater environmental and social risks to both upstream and downstream human communities.

Studies of climate change across the Greater Himalayas portray a very uncertain future, yet governments of countries in the region have been slow to begin planning for climate adaptations. There are still many information gaps, and data that do exist are complex and often difficult to interpret. Integrated ecological, hydrological and social studies have yet to be completed. The problem is that people must act now in order to reduce future negative consequences.

In order to help citizens, community leaders, politicians and policymakers understand better projected climate-change impacts in the Greater Himalayas, we performed a comprehensive review of current studies with an eye toward cascading effects on water, biodiversity and human livelihoods. Cascading effects are those unanticipated events that result as ecosystems respond to change. When these effects are accounted for, a more nuanced and problematic picture of regional climate impacts emerges.

The Greater Himalaya region, also known as "Asia's water tower", covers some seven million square kilometres and has a highly heterogeneous geography: from subtropical semi-desert and low tropical evergreen forests, to alpine ecosystems below the highest peaks in the world. The Himalayan massif affects regional weather; the mountains form a physical barrier to atmospheric circulation for the summer monsoons and winter westerlies. Species and ecosystem diversity is high; of the world's 34 biodiversity hotspots, four are found here. Beyond biodiversity, the Greater Himalayas form the headwaters of 10 of the largest rivers in Asia, whose basins provide water for about 1.3 billion people.

> *Some 22% of all people on earth are sustained by Asia's water tower, but there are no full-scale studies of how climate change may reduce downstream flows.*

Climate-change impacts are already occurring in the Greater Himalayas, most notably the widely reported reduction of glacial ice. Regional temperatures are increasing at about three times the global average. United Nations Intergovernmental Panel on Climate Change (IPCC) 2007 data, now considered by many to be too conservative, project further warming of 3° Celsius by 2050 and about 5° Celsius in the 2080s over the Asian land mass. Warming will be even greater on the

Qinghai-Tibetan Plateau. Though glacial loss may be mitigated somewhat by projected increases in precipitation, the best current projections show that ice may disappear from the Greater Himalayas by mid-century or before.

Water is a critical resource for ecosystems and people; there will be multiple cascading effects from the reduction of Greater Himalayas ice and snow. Processes determining the conversion of frozen water into downstream flow are complex, but based on current knowledge the rivers most likely to experience the greatest reduction in water availability are the Indus, Yangtze, Tarim, Brahmaputra and Amu Daryu. The Indus, for example, gets 44.8% of its stream flow from melt water. The Yangtze receives somewhat less than 20%. Reductions in these flows should trigger concern: the number of people living in these two basins is 178 million and 368 million, respectively.

Species are already responding to climate change in the Greater Himalayas. Rhododendrons are flowering up to a month earlier than historical averages. For other plants, rising temperatures are altering the timing of flowering and leaf flush and these changes will cause cascading effects in the behaviours of pollinators and other flower-dependent animals. Historical plagues of the high elevation Tibetan migratory locust, for example, are closely related to droughts. Spider predation on grasshoppers decreases with rising temperatures. In general, the overwintering eggs of insect pests are likely to have higher survival rates with warmer winters, which will lead to more herbivory on crop plants. Weedy, exotic species from lower elevations will likely invade into higher areas. Less water and disruptions of the normal timing of ecological events will have uncertain consequences for many species; some species will decrease, some will increase. The potential for species extinctions due to climate change has been reported widely, but the consequences of complex cascading effects are underappreciated by most people.

Ecosystem dynamics are expected to change, too. It is highly likely that the composition and distribution of vegetation types throughout the Greater Himalayas are very likely to shift significantly. Water timing and availability influence where high-altitude meadows, steppes, grasslands and deserts are distributed. Today on the Qinghai-Tibetan Plateau, alpine steppe and deserts cover 33.5% of the region; these ecosystems are expected to contract in area by about 16%. Forests on the Plateau are projected to increase in area. Since 1923, tree lines have shifted upward by 67 metres in northwest Yunnan province, while over the last decade in the western Himalayas, upward shifts have averaged about 16 metres. It remains unclear what such wholesale shifts in plant communities will mean for ecosystem functioning over time.

Water availability, species interactions, ecosystem shifts and stability are linked by multiple ecological feedbacks, but basic research exploring these interconnections is notably lacking in the Greater Himalayas. To complete our review, we focused on two broad categories of cascading effects: ecosystems and livelihoods impacts; and downstream and global consequences.

One primary concern we have with impacts on ecosystems and livelihoods is the unprecedented speed and scale of projected climatic changes. Many of the endemic species that live in the Greater Himalayas may not be able to adapt to such rapid transformation of the environmental conditions that they have evolved in. This same logic applies to humans. For people, effective climate adaptations include the capacity to gather and interpret new information, the creation of responsive governance, as well as actual changes in livelihood practices to meet changing conditions. Climate change is not new for Himalayan people. Mountain dwellers across many cultures, for example, have used riverbank retaining walls and terraces to mitigate flooding, as well as regional migration to avoid the worst environmental hazards. But there are virtually no studies that examine existing adaptive capacities and potential

vulnerabilities of local communities across the Greater Himalayas.

Quantitative projections of potential downstream and global cascading effects due to climate change are also rare. We are especially concerned about cascading effects influencing downstream water availability, atmospheric circulation, sea level rise and loss of Qinghai-Tibetan Plateau permafrost.

Some 22% of all people on earth are sustained by Asia's water tower, but there are no full-scale studies of how climate change may reduce downstream flows. Reduced downstream flows mean reduced food production in a region where there are already 523 million undernourished people and population growth rates are some of the highest in the world.

While regional food production is critical to the well-being of many people, the Greater Himalayas also play a key role in global atmospheric circulation. In summer, the vast highlands heat up more than the Indian Ocean, leading to a pressure gradient that drives the Indian monsoon. There is some evidence, however, that this gradient may be changing due to the reduction of ice and snow in the Greater Himalayas.

Loss of regional ice and snow will have still-unknown cascading effects on global sea-level rise. Recent research projections have doubled the worldwide minimum average rise to 80 centimetres by 2100, which would have severe effects on human populations and agricultural lands in the coastal mega deltas of Asia, where Greater Himalayan rivers meet the sea.

The Greater Himalayas are also an important carbon sink. Frozen soils subtending Qinghai-Tibetan Plateau grasslands store some 2.5% of global soil carbon, but projected warming and the resulting shift in ecosystems could lead to the near-complete disappearance of permafrost, with the cascading effect of releasing most of the region's soil carbon. No model exists yet that captures the interactions of these critical variables: melting glaciers and snow; degraded permafrost and wetlands; shifting alpine ecosystems; and potential changes in monsoon moisture patterns.

Current trends portray great environmental uncertainty in the Greater Himalayas. Given the general lack of data and levels of scientific uncertainty, we recommend: more widespread and long-term tracking of glacial ice volumes; monitoring of high-altitude flora and fauna; open sharing of data; and greater cooperation between all countries in the Greater Himalayas. At the local level, we believe upstream rural people should be brought into natural resource decision-making. Policies addressing downstream populations, urban infrastructure, and large-scale agricultural systems must be integrated with mountain peoples' livelihoods issues and concerns. River basin research should emphasize reducing overall water demand and modernising irrigated agriculture with maximal efficiency in mind.

Across all countries in the Greater Himalayas, risk assessment and mapping would help decision-makers select appropriate strategies. But we found no regional or transboundary authority addressing the complexities of climate-induced cascading effects outlined here. This situation must change. China and India play critical roles because most of the Greater Himalayas are within the borders of these two nations. We would like to see these two countries exert more leadership. As much as we would welcome the formation of a regional Greater Himalayan climate-change authority, we recognise that top-down policymaking has a mixed track record in the region. But current evidence and the potential for severely negative cascading effects show that the status quo can no longer hold; political leaders must act.

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Dr Xu Jianchu works at the Key Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany and the World Agroforestry Centre, China Program, Kunming, China. He focuses on river basin biodiversity and local livelihoods throughout the Greater Himalaya.

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Image by DexterPerrin

February 07, 2012

The face of Sanjiangyuan

As global warming and economic development alter landscapes and lives in western China, Hashi Tashidorjee has been out with his camera. Here he shows the third pole the results.

The Sanjiangyuan region of the Qinghai–Tibet plateau contains the headwaters of three of Asia's major rivers: the Yangtze, the Mekong (also known as the Lancang) and the Yellow River. This delicate corner of western China is known as the country's "water tower". But, against the background of economic development and climate change, its high grasslands are quietly changing.

For many years, Hashi Tashidorjee of local NGO the Snowland Great Rivers Environmental Protection Association has been documenting these changes and their impacts on the lives of local herders in photographs. Here, he talks chinadialogue's Zhou Wei through a series of the pictures he has taken, and the stories behind them.

Hashi Tashidorjee is vice secretary-general of the Snowland Great Rivers Environmental Protection Association.

Zhou Wei is assistant editor in chinadialogue's Beijing office.

Images by Hashi Tashidorjee

THE FACE OF SANJIANGYUAN

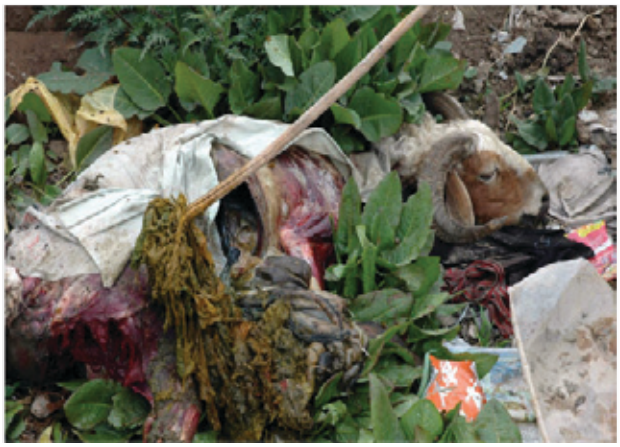
***The Amne Machin Snow Mountain**, in Golog prefecture, Qinghai, is one of the sacred mountains of the Qinghai–Tibetan Plateau. This important source for the Yellow River – it is the only glacier that feeds into the waterway – is currently receding. This photograph was taken late in the year (in November 2009) but, under the noon sun, the icicles are dripping. Every year, glacier avalanches terrify the locals, who revere the sacred mountain. Local lama Wangqiong says it's a lack of concern for others in the world that is causing the glacier to shrink.*

Desertification is visible in Yanzhanggua Valley, Yushu prefecture, on the upper reaches of Sanjiangyuan's Tongtian River. I remember walking on this grassland when I was little and there was no sand back then. There was one pass we used to take to cross the mountain and it was completely clear. Twenty years later, the pass is full of sand and the blockage has created a lake. The Tongtian River – an upper stretch of the Yangtze – flows through this place, and every summer the desert turns the river water yellow. This picture was taken in 2006.

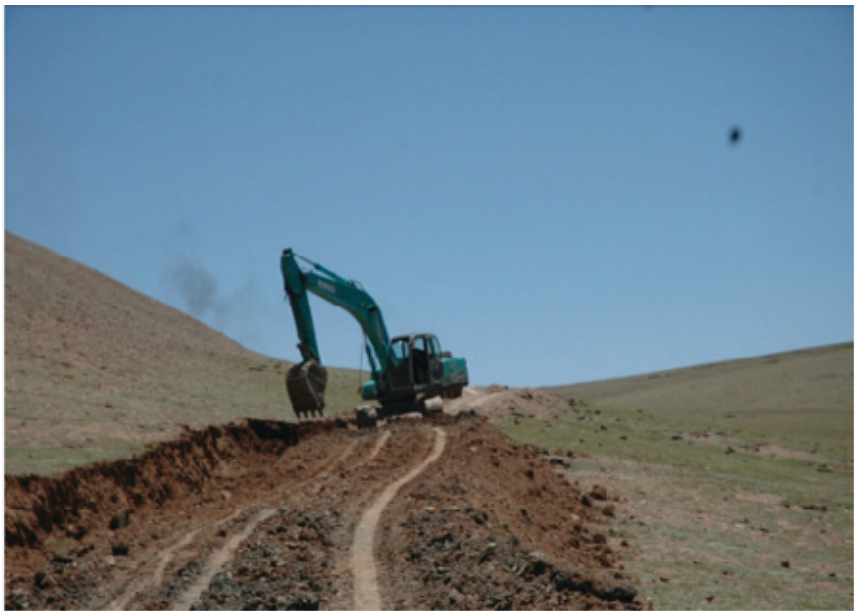
This photo, which was taken by Wang Xin, reminds me of my friend Suonan Dajie, who was killed trying to protect the Tibetan antelopes of Kekexili. The poachers got him in the end, as well as these antelope. In Sanjiangyuan, destruction of wildlife, fauna and ecosystems seems constant. For me, this is the impact of a system that places so much weight on markets, trade, capital and power. People may dress up the unfettered consumerism at the heart of global markets as science and technology, national development and an effort to eradicate poverty. But, ultimately, it destroys life. That is what killed Suonan Dajie and the antelopes.

This is a lumber plant on the upper reaches of the Lancang River. Felled trees are put in the river to float downstream to the processing plant, where they are fished out of the water and placed on a conveyer belt to be cut up into planks. The locals deplore what is happening. They say felling teams are progressing along the banks of the river and will soon reach the foot of the sacred mountain. The Lancang is an international river – are there rules about where felling can take place and to what extent? We locals don't know these things.

This picture was taken one morning in 2009, before the Yushu earthquake on the Zhaxikecao Grasslands of Yushu. Plastic detritus lies scattered along the roadside, while a shepherd boy walks behind his sheep, a satchel slung on his back. I remember the grasslands of my childhood: the roads were lined with wild flowers, cattle and sheep. It made you break into song. Children today walk through rubbish. What are they going to sing?



These sheep died after eating plastic garbage near Jiegu town in Yushu, in 2009. It's common for livestock to die after accidentally eating waste that litters the town and surrounding grasslands. In 2003, the Sanjiangyuan Commission persuaded the Yushu government to ban plastic bags, but it didn't last long. For effective environmental protection, the government and the people need to work together over the long term. The herders now have their own environmental protection movement. There's an annual ecological festival at the source of the Lancang River, where the local lama encourages people not to use plastic bags. Five hundred herding households have made an oath to follow his instructions. I hope that, in future, plastic pollution won't be a problem in Sanjiangyuan.



Roads here are badly designed and cars and vehicles often drive onto the grass, packing down the soil until grass can no longer grow there. Roads and power lines have torn open the grasslands, leaving wounds that struggle to heal. The wind and rain get in and make the wound bigger. Installing a single power–transmission pole requires large amounts of soil to be excavated, and the planners never consider the environment – sometimes they even cut right through water sources.

Thousands of herder families, called "ecological migrants", have been relocated away from the grasslands. The Sanjiangyuan area is the "water tower of Asia" and home to a unique alpine grassland ecology. But, for the locals, the ecosystem involves people as well as nature. Properly identifying the environmental issues here requires serious research. Without that, remedial actions may have unintended consequences, and even make things worse. Even within Sanjiangyuan, different regions and different altitudes have their own ecologies, and you can't apply the same policies wholesale. Protecting the environment is a matter of culture, society and ecology. It's not clear that the ecological migration policy has taken this into account.

These fences, photographed at Maduo at the source of the Yellow River in 2003, designate grassland ownership. In the past, there was no such thing. Herding was traditionally tribal, and the tribe moved around to find land for grazing. Fencing off the grasslands doesn't suit local characteristics and fails to take into account how wildlife, plants and people interact. Birds can't see the fences, and many have been snared on the wires.

A Tibetan wild ass is trapped by a fence in the Suoka area of Zhiduo county. After the fences went up, the wild ass and other animals lost their habitat. We once saw a young ass and its mother stuck on opposite sides of a fence. The rare Przewalski's gazelle, which lives by the shores of Qinghai Lake, is also entrapped. Some get stuck as they try to get over the barriers and die a slow death. Some try to get to the lake to drink, but don't have the strength to get over the final fence. One herder goes around helping bharals (also known as Himalayan blue sheep) who get their horns caught. In one winter alone, he freed 49 of them.

The distribution of wild animal populations wasn't considered when the fences were erected.

Part 2: Glaciers and climate change

The impact of climate change on Himalayan glaciers is as complex as it is perilous. Reports about the melting of some glaciers in the Himalayas – and the advancing of others – have sparked heated debate. But comprehensive scientific data on climate change's effects on Himalayan glaciers are woefully lacking. Since its inception, thethirdpole.net has reported on the science that is beginning to emerge from this understudied region.

In this section, Isabel Hilton talks to development specialist Andreas Schild about the current state of scientific knowledge in the region and the need for greater regional cooperation. Glacier scientist Kenneth Hewitt explains regional variance in glacier melt and warns against oversimplification. Former water minister of Nepal, Dipak Gyawali, explains the importance of approaching Himalayan climate change from the grass-roots level. And Jenny Johnson warns policymakers to pay more attention to the power of black carbon to accelerate ice melt in the region.

Glaciers and climate change
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August 24, 2009

Glaciers and guesswork

The "third pole" is hugely vulnerable to the effects of glacier retreat – but the science is scarce. Isabel Hilton speaks with Andreas Schild, a specialist in the Hindu Kush-Himalayan region.

Andreas Schild was director general of the International Centre for Integrated Mountain Development (ICIMOD), based in Kathmandu, between 2007 and 2011. ICIMOD works to develop an economically and environmentally sound mountain ecosystem to improve the living standards of high-altitude populations in the Hindu Kush-Himalayas and to sustain vital ecosystem services for the billions of people living downstream. A development specialist, Schild spoke at the "Kathmandu to Copenhagen 2009" conference, which focused on South Asian countries' vulnerabilities to climate change and aimed to catalyse a common Himalayan response. Isabel Hilton, editor of chinadialogue, spoke to him before the conference.

Isabel Hilton (IH): Since the last IPCC report – the Fourth Assessment Report of the Intergovernmental Panel on Climate Change – many scientists have said that climate change is moving faster than was reflected by that assessment. Is this your observation with respect to the "third pole" – the Himalaya and the Tibetan plateau?

Andreas Schild (AS): We cannot confirm this statement and the main reason is that we do not have directly available reliable and consistent data. This is also the reason why the IPCC Fourth Assessment hardly mentions the Hindu Kush-Himalayan region. We are presently involved in a review of the situation of the glaciers and we can confirm that the retreat of glaciers, which has already been reported, is taking place and is accelerating.

However, we hesitate to make such a statement, because we have to see what kind of glacier we are speaking about. We also have to be aware that certain glaciers – large glaciers in the Karakorum, for instance – are growing. But even this statement tends to create misunderstandings: the growing is probably due to changing precipitation patterns, perhaps more precipitation in the winter season due to westerly winds. But this is an intelligent guess, which for the time being cannot be supported by science. Glaciers, which depend on the monsoon in the western Himalayas, tend to be receding quicker.

> *"The bottom line is that for the Hindu Kush-Himalayan region, we do not have reliable data and we do not have the monitoring instruments in place to make clear statements."*

Glaciers are excellent indicators because change is immediately visible and understandable for the layman. But addressing the changing precipitation patterns of the monsoon and changing biodiversity require much more refined monitoring tools. The bottom line is that for the Hindu Kush-Himalayan region, we do not have reliable data and we do not have the monitoring instruments in place to make clear statements.

IH: Is it possible to detail the projected impacts on regional downstream countries? Do you see any connection, for instance, between the retreat

of the glaciers and such phenomena as the failure of the Indian monsoon this year, or the floods and typhoons in China and Taiwan, or are these coincidental phenomena?

AS: It is very dangerous to take punctual, one-time events and interpret them for the explanation of a global phenomenon. We need multi-annual data chains and have to apply modelling techniques, which indicate certain trends. To refer to isolated events and interpret them directly is very risky. Studies of such major events as floods in South Asia since the 1960s tend to indicate that they are the product of locally isolated outbursts, which as typical for mountain systems. The trend is that they are recurring more frequently and with greater amplitude.

IH: What do we know and how do we know it? It is a vast and varied region, but in some respects it is one huge ecosystem fragmented across several countries. How important is it to reach a comprehensive scientific understanding of the region scientifically, and is that possible?

AS: We have to accept that within the Hindu Kush-Himalayan region there are great variations. In mountains, we have to accept that there are very local and rapidly changing extreme situations and events. From this point of view, it is not possible to make sweeping statements for the whole region. However, what is possible is to make longitudinal and latitudinal transects, which allow observations and conclusions for sub-regions, water basins or specific systems. ICIMOD is working on such a concept with the regional partners and finds an encouraging interest among the specialists.

In order to become relevant, this needs firm and long-term commitment from the governments. At this point, we have to define relevant sub-regions where comprehensive statements can be made. Political borders do not usually define these: they are transboundary and cross political borders. I am referring here to river basins, to landscape corridors and so on.

The difficulties are that, in the past, data gathering and interpretation has been done on an ad hoc basis, project-wise and without continuity. The governments have not given priority to such phenomena. The consequences are a high presence of external actors, such as universities, which do a lot of research but do not necessarily coordinate. Another difficulty is the different level of capacity of the institutions, which does not facilitate the exchange of information, and a lot of data are not exchanged because of institutional, political and personal reasons.

IH: What role does satellite monitoring play in advancing our understanding of what is happening? Is it enough?

AS: Remote sensing instruments and satellite imagery is very useful indeed and is making quick progress. Such instruments are very useful for the indication of trends and for general interpretations. In practice, though, these instruments have to be accompanied with in situ investigation and observation. Modelling based exclusively on remote sensing has too great a variability compared with field observation.

For example, we have a fairly good view of the growth and retreat of glaciers and glacial lakes based on remote sensing. However, we cannot estimate reliably the quantity of ice available, the mass balance and the evolution of the ice quantity. This is highly relevant to estimates of the water stored in the form of ice, and water availability during dry season for irrigation. Even more critical is the assessment of permafrost through remote sensing. Such observations are of great importance in order to assess such disaster risks as moraine breaks and landslides.

IH: How would you assess the region's readiness in terms of awareness of the impacts, adaptation and mitigation strategies?

AS: It is very difficult to answer a question that encompasses so many countries and the substantial differences between awareness, adaptation and mitigation. We can safely say that the awareness of

the consequences of climate change has substantially increased. Some regional countries make a substantial effort. However, their positions depend greatly on the prevailing situation in the respective countries.

There are extreme cases in the region, such as Afghanistan, Nepal and Myanmar. All the three have very specific internal agendas and priorities. Nepal is an extreme case because it is potentially a main loser and winner at the same time. However, climate change is very low on the political agenda.

In the conference at the end of August – which is exclusively donor-driven by the World Bank, DfID [the UK Department for International Development] and Denmark – the interest is mainly in how much participants can get through the carbon trade facilities. At the other extreme is Bhutan, which is branding itself as a green, environmentally conscious country. India and China are doing a lot in terms of adaptation and are very active. The same can be said of Pakistan, which is extremely worried because of the consequences for food security. Bangladesh can make important investments thanks to donors like DfID.

Mitigation is a completely different chapter and cannot be answered in a professional way in this context. The difficulty for the big regional countries is that mitigation is directly linked with growth. From the mountain perspective, ICIMOD is focusing clearly on adaptation. The global debate on mitigation will only have long-term effects. In the meantime, it is essential to strengthen adaptation and build resilient communities. Practically, this means that the adaptation agenda has to be linked closely to other agendas. Poverty is the overriding issue; for mountain communities, globalisation, migration and isolation also are concerns.

Mountains are largely suffering from climate change and are not the polluters. On the other hand, they have not benefited from the carbon-trading facilities. The global architecture, data availability and transaction costs do not favour them. We fear their potential will also be limited in the future. This could have dramatic consequences. Mountains are very sensitive systems and are fragile. The ecosystem services in terms of water, biodiversity, cultural heritage, space for recovery, tourism and so on will be affected. This will influence food security, particularly in Asia, where the main rivers are highly dependent on mountain and snow and ice discharge.

IH: What are the risks of lack of preparedness?

AS: Again, a very difficult question. Talking of preparedness, let's look at disaster preparedness. Most dangers are not new; local communities have learned to adapt to new risks and have developed a substantial amount of resilience. They continue to learn. Most critical is the arrival of change due to external actors. Very often schoolhouses are built on marginal land or in very exposed situations. The same holds true for health posts. Thanks to the availability of soft money in poverty alleviation funds, some of the most popular investments are access roads. Because they are built ignoring all principles of engineering, new vulnerabilities due to climate change are created. The effect on water, biodiversity, required land cover and land use are rather slow processes.

The most immediate risk of lacking preparedness is the loss of life and assets. To ignore the risks is to create prospective loss and the destruction of investment goods. The higher the investments, the more relevant knowledge is, rather than preparedness. High investments require a good knowledge of risks that originate in climate change and the prospective investment.

For example, on the Tama Kosi, a river in the Kosi system, hydropower stations for an installed capacity of 938 megawatts are planned. Upstream, on the Chinese side, 40 potentially dangerous glacial lakes are identified. The planners have no long-term data of the water flow and have to plan to protect these investments from undue and incalculable risks. The planners must include so many safety measures to protect the investments that either the investment

costs or the risks are very high. The lack of knowledge is therefore making it difficult to take well-informed decisions, which implies the danger of promoting unproductive investments.

IH: In what areas do we need greater cooperation?

AS: First of all, we should close the knowledge gaps. This means making knowledge and data that basically exists available and accessible. Then we need institutions and mechanisms to build up knowledge banks and monitoring facilities. This means institution-building, which is highly unpopular among the donors, and increased research capacity in local specialised institutions and universities. The third important element is the promotion of the transboundary exchange of information and co-operation. Fourthly, the donors: the traditional development agencies have made a lot of progress, at least verbally, in donor coordination, basket funding [joint funding by several donors] and national ownership.

On the other hand, we realise that within the frame of globalisation, traditional donor countries have created new instruments of international cooperation. In a globalised world, there are no external politics, just global interior politics – so technical ministries have received funds to cooperate with stakeholders around the world. Climate change means that for one specific country, different actors make contributions, cooperate and do research without any substantial coordination capacity within the respective country. Climate change is creating new channels of cooperation, without clear coordination and consultation mechanisms.

From ICIMOD's point of view, we think more information and awareness has to be created in what in the west is called civil society. Knowledge has to be increased among multipliers to be able to influence the political agenda. Such information should definitely illuminate the dangers and risks, and at the same time create new opportunities, particularly for mountain countries.

IH: How can this situation be improved?

AS: Probably the single most important element in the countries, but also for the donors, is the commitment to more long-term objectives – for continuity, which also implies awareness creation and institution building. I think another very important element is the promotion of development potential in the countries themselves and being aware that there are other important agenda points as well as climate change.

IH: What are the risks of failure to achieve cooperation?

AS: The risks are increased vulnerabilities, less-than-optimal allocation of resources and increasing development gaps.

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Isabel Hilton is editor of chinadialogue.

Image by Charles Masters

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Understanding glacier changes

The impact of climate change on Himalayan glaciers is as complex as it is perilous. Kenneth Hewitt explores the hotly debated world of melting – and expanding ice.

Image shows the upper Chiring-Panmah Glacier, and illustrates the prevalence of steep rock walls in the upper parts of these glacier basins. The avalanches coming from them have left cones of snow at the base of all the slopes. June 2005.

Ablation zone conditions where annual ice losses are high: dust, dirt and scattered debris areas on Kaberi-Kondus Glacier, late June, at 4,000 metres above sea level. 1998.

Glaciers are quite sensitive to climate change and, recently, there have been many reports of major changes in the Himalaya and other parts of High Asia; mostly of glaciers retreating fast. Impacts of a range of glacier hazards, and on the reliability of water resources, are of concern at local, national and transnational scales. However, there is also a growing recognition that glacial conditions in the region are very diverse, and so are their responses to climate change.

> *One must qualify the notion that threats only arise from 'disappearing' glaciers or in proportion to the rate of reduction.*

There are some very different implications in different societal contexts, not least in relation to rapid socio-economic changes, water resource projects and security crises. The latter are often more urgent or immediate problems that disrupt or undermine peoples' capacities to adapt to environmental change. Such complexities are the focus of this article. The reality of climate change is not questioned, but some recent oversimplifications are, and claims about a narrow range of glacier hazards. In particular, unresolved problems of understanding high altitude glaciers and climate are emphasised, and the inadequacies of available information and monitoring. Recent evidence of glacier advances in the Karakoram Himalaya, and the author's work there, illustrate many of these complexities.

Globally, most glaciers are reported to be diminishing more or less rapidly. Reports of "disappearing glaciers" have come from many parts of High Asia. However, this is not the case in the upper Indus and upper Yarkand River basins. Here, the glaciers have been holding their own for several decades and recently, in the Karakoram Himalaya, many have started thickening and advancing. Not only is this opposite to the broader picture for Eurasian glaciers, but also to what had been happening to Karakoram glaciers. Through most of the twentieth century they

too diminished and retreated. There is no question that today's behaviour is a regionally distinct response to climate change. It may sound like good news, given the dominant lament for the loss of glaciers, but that too would be misleading. Advancing glaciers bring dangers as well.

Of immediate concern are a number of glaciers on the Indus and Yarkand Rivers, whose past advances gave rise to large ice dams and catastrophic outburst floods. In the longer term, existing and planned water resource uses, dependent on glacier-fed streams or at risk from glacial floods and sedimentation, are of major concern. However, the largest challenges stem from inadequate information and monitoring, and limited scientific understanding of these high elevation glaciers. Misleading or exaggerated reports based on assumption rather than evidence are also a problem. Some high profile reports have suggested that the Indus basin is in imminent danger of losing its glaciers. Glacier hazards, notably "dangerous lakes" associated with retreating ice in other regions, have been assumed to be equally present in the Karakoram. The reports are simply wrong in this case.

Meanwhile, if the main trend in most of High Asia does seem to be glacier retreat, various lines of evidence show that it is occurring at very different rates in different mountain ranges, even within the same mountains. A 2006 survey of 5,020 glaciers in the mountains of western China and the Tibetan Plateau found widely differing rates of reduction. It also found 894 glaciers, about 18%, have advanced in recent decades. The jury is still out on a 2009 report from India, which questions the scale and reality of the extreme rates of retreat formerly reported for the Himalayas, and projections based on them.

None of this is to suggest that climate change is not a serious issue in the Karakoram. In every valley of the region farmers tell me the winters have grown shorter in the past couple of decades, there is less snow and more rain. They report an increase in windstorms and rain during summer. Formerly, clear, sunny weather in autumn was reliable and perfect for drying grain,

The surge of the Maedan tributary of Panmah Glacier. Notice severe crevassing of ice. June 2005.

Panmah Glacier accumulation zone, showing surrounding rock walls up to 2,500 metres high around the Latok Peaks, June 2005.

fruit and winter fodder, and for post-harvest chores around the villages. Not any more. They report increasing problems with damp and mildew from insufficient drying days. Rain and wind threaten the harvest and damage buildings. These are, in fact, more immediate hazards for the mountain communities than anything that may be happening to the glaciers. This refers to the inhabited areas at lower elevations, where more, and more severe, rainstorms have been reported in recent years, notably a disastrous storm on September 9, 1992. It triggered rockfalls and debris flows that damaged many villages, closed most roads and stranded tourists. Again, advancing glaciers are also a response to climate change – and are not necessarily good news.

Although there have been reports and discussions of Karakoram glaciers since the mid-nineteenth century, they have been patchy in space and time and of varying quality. The glaciers are not, and have never been, consistently monitored. Few glaciers anywhere in the inner Asian mountains meet the criteria of the World Glacier Monitoring Service, and hence have not been tracked by it. The cries of concern for these glaciers should at least highlight the need for more reliable data and a better grasp of climate-glacier interactions in the world's highest mountains.

The glacier cover of High Asia exceeds 110,000 square kilometres, the number of identifiable glaciers more than 50,000. There are major concentrations in about a dozen mountain ranges, forming watersheds of all the major rivers of the central, south and south-east Asian mainland. The Upper Indus and Yarkand basins have around 21,000 square kilometres of glaciers, the larger fraction in the Greater Karakoram, or about 16,500 square kilometres. Most of the biggest valley glaciers outside polar regions are found here. While there are more than 5,000 individual glaciers, just 12 make up almost half the ice cover. Melt waters from glacier basins comprise more than 40% of the average annual flows of the Indus and the Yarkand, with a potential to affect the lives of some millions of people downstream. While there was a roughly 10% reduction of the Karakoram ice cover in the first 60 years of the twentieth century, no significant reduction has occurred in recent decades and, as noted, many glaciers are undergoing advances.

One must qualify the notion that threats only arise from "disappearing" glaciers or in proportion to the rate of reduction. This is certainly a cause for concern, in itself or in what it implies about humanly induced atmospheric changes. But growing glaciers are not necessarily benign. In most glacierised mountains, certainly the Karakoram Himalaya, the worst consequences experienced in recent history came with the enlarged ice cover of the Little Ice Age: a period of several centuries, ending just over 100 years ago, when glaciers grew throughout the northern hemisphere. From those events come most of the stories and fears about glaciers recalled in Himalayan towns and villages. The considerable reduction of the glaciers observed between about 1910 and the 1960s was, in effect, removing ice stored in the Little Ice Age, a process that is not yet complete. Today's glaciers are larger than a few centuries ago. Meanwhile, the evidence of advances in the Karakoram not only indicates a different response here to changing climate. It raises the prospect of a return to the hazards of advancing ice not seen since the Little Ice Age.

Accounting for variety

Climate change is obviously having different consequences in different mountain areas of Asia. The situation in the Karakoram must represent some distinctive conditions. Three features of the regional environment seem critical. The first two relate to snowfall and the nourishment of these glaciers. They are intermediate in type between the summer accumulation (snowfall) glaciers of the greater Himalayas, and the winter accumulation glaciers of, say, the Caucasus and European Alps to the west. In each of the latter, more or less strong glacier retreat is reported. Second, the zone of maximum precipitation in the Karakoram is much higher than in these and most other mountain ranges. It is also entirely within the accumulation zones of the glaciers. This relates to the third factor, the exceptional elevations and, especially, elevation range of these ice masses.

The glaciers of large and intermediate size originate at very high altitudes and many of them descend much lower than elsewhere in the sub-tropics. Five glaciers span more than 5,000 metres in elevation, 15 over 4,500 metres and more than 30 over 3,000 metres. In the Hunza valleys of the central Karakoram, glacier termini advance below 2,300 metres above sea level. Those on the north flank in the Yarkand drainage do not descend so low because the valleys are at greater elevations, but they include several descending more than 4, 000 metres, due to location in the very highest parts of the range around K2 (8,610 metres). All of the glaciers recently observed to be growing are in

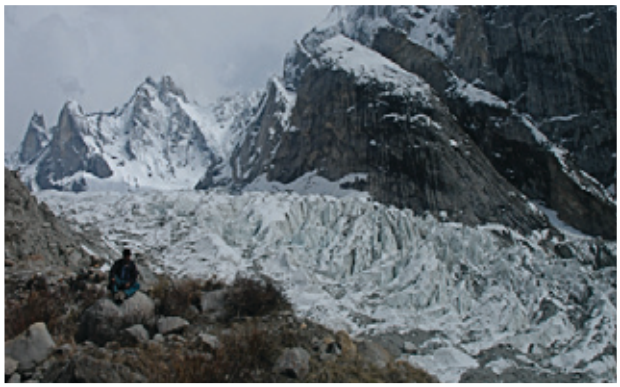
these high-relief basins. Of special interest, but poorly understood, is how elevation and topography interact with the regional climatic influences to determine the behaviour of the glaciers.

The regional climate of this south-western part of the Inner Asian mountains comes under the influence of three different, seasonally varying, weather systems. First, the winter half of the year is dominated by a westerly or "sub-Mediterranean" circulation. Second, in summer, moisture comes from the Indian Ocean to the south and the climate becomes "sub-monsoonal". Third, inner Asian high-pressure systems, especially involving the Tibetan Plateau, interact with the other two systems to affect storm paths and the incidence of clear weather. The last is critical, since direct solar radiation is responsible for 80% to 90% of melting on the glaciers.

> *Investigations on the glaciers at higher elevations have revealed how different conditions are from the valley weather stations – mostly below 3,000 metres above sea level – whose records had dominated climatic interpretations.*

Global climate change is expected to alter the absolute and relative roles of all three systems, a likely factor in recent developments that complicates forecasting of future glacier changes. Meanwhile, investigations on the glaciers at higher elevations have revealed how different conditions are from the valley weather stations – mostly below 3,000 metres above sea level – whose records had dominated climatic interpretations.

Station records from the inhabited areas of the Karakoram show two-thirds or more of precipitation occurs in winter, mainly February through May. The average annual precipitation in these valleys is 150 millimetres to 300 millimetres water equivalent – an arid or semi-arid environment with severe summer drought. However, a very different story emerged



Icefall on Charakusa Glacier, east-central Karakoram. June 2005.

from our measurements on the glaciers in the 1980s. At elevations above 4,800 metres we found that snowfall amounts are roughly the same in summer and winter, with roughly equal amounts coming from the west and the Indian Ocean. Summer drought was not observed on the glaciers especially in their accumulation zones above 4,500 metres above sea level. Moreover, the zone of maximum precipitation turned out to be between 5,000 metres and 6,000 metres above sea level – much higher than in, say, the eastern Himalaya or any other reports from tropical mountains. Moreover, accumulation zone snowfall is equivalent to between 1,000 millimetres and 2,000 millimetres of water; far more moisture than the valley stations suggest. What is identified here is a powerful gradient in climatic conditions with elevation – a five- to 10-fold increase in precipitation from glacier termini around 2,500 metres above sea level, to where the snow falls that nourishes the glaciers. A recent, pioneering study based on satellite imagery – conducted by Bibi S Naz and colleagues at Purdue University in Indiana – suggests snowfall amounts and the extent of perennial snow cover have increased in the past couple of decades at high elevations in the Central Karakoram.

Vertical gradients also define key conditions for the melting of the glaciers, and their contribution to water supply. In fact, although many ice tongues descend much lower, the decisive conditions for melting occur

between 3,800 metres and 4,800 metres above sea level. Here lie more than 80% of the ice surfaces where melting occurs in summer. Ablation conditions – under which ice melts – also identify complexities that arise with timing and seasonal rhythms as well as elevation. Nearly all the melting and water production of the glaciers occurs in just a few weeks of summer, when temperatures rise above zero and strong sunlight occurs. In turn, this explains why 70% to 80% of the flow of the upper Indus and Yarkand rivers occurs in six to 10 weeks of summer – usually in July and August – lagged until winter snow sitting on the ablation zone has melted away to expose the ice. Moreover, melting is very sensitive to summer cloud cover or storms. A sudden summer storm can shut down melting for days at a time. Just when and for how long rapid and extensive melting occurs varies greatly from week to week, and year to year. It is one of the most sensitive variables affected by climate change.

Another huge and poorly understood fact is that most Karakoram glaciers are largely or wholly avalanche-fed. The accumulation zone areas of these glaciers, above about 4,600 metres above sea level, are generally 70% to 80% steep rock walls. The larger part of high altitude snowfall in the region is on to these unstable slopes, and is avalanched more than 1,000 metres before incorporation into a glacier. It seems likely that changes in snowfall amounts, with season or in storm intensities, will alter the timing, temperature relations, and extent of avalanching. This can, in turn, affect glacier behaviour. The trouble is, there are no data or research to help predict what climate change does to this all-important part of the nourishment of the glaciers.

What can be said is that what happens between 3,800 metres and 7,000 metres above sea level is absolutely critical to the role of climate and climate change in glacier behaviour and survival. These are also the elevations where the reasons for the seemingly anomalous recent responses of Karakoram glaciers must be sought. However, it is here that the least research has been done. There are no permanent

Summer storm on the Baltoro Glacier at 4,600 metres above sea level, at the limit of rain (below) and snowfall (above). The exceptional height to which there was rain seems to reflect climate warming. However, at the height of the ablation season the storm virtually shut down melting here and greatly reduced it lower down. August 2005.

Middle ablation zone of Biafo glacier after the first winter snowfall in October, 2009. The main glacier is over 500 metres thick here and 3.5 kilometres wide. 2009.

measuring stations or long-term monitoring. To recognise how unfortunate that is, we need to address changes that are, or may become, unusually threatening to human communities and activities.

Understanding risks

Glaciers and their immediate environs present many dangers for humans, such as crevasses and glacier mills into which one might fall, heavily crevassed ice falls,

snow and ice avalanches from the side walls and, along the flanks, dumping of great boulders, ponding and floods from melt water. For these reasons, there are hardly ever permanent settlements on or right beside the ice. These are hazards mainly to mountaineers, hunters, travellers and military expeditions. The more serious dangers arise from processes in the glacial environment that may extend their impacts beyond existing glacial areas. The more serious tend involve ponding of water that leads to glacial outburst floods, or releases that generate debris flows.

The risk of glacier lake outburst floods has received particular attention in other parts of the Himalaya, notably Bhutan, Nepal and Tibet. In Nepal, some 25 glacial lake outburst floods have been recorded since the 1930s, with especially destructive events in 1985 and 1991. Bhutan also has a number of dangerous lakes, one of which burst with disastrous consequences in 1994. Reports suggest all of these lakes and the triggers for outburst floods are related to climate warming and glacier retreat. There is also a history of such outburst floods from Karakoram glaciers. However, the problem here is also very different from that recently reported elsewhere in the Himalayas. In particular, the most serious threats involve, specifically, much larger impoundments by short-lived, unstable ice dams. Crucially, all recorded examples have been associated with advancing glaciers.

In fact, the Karakoram presents two rather different groups of outburst floods. The most frequent are relatively local events. Collectively, they threaten dozens if not hundreds of small settlements in the higher valleys and examples occur in most years. They involve a wide variety of dam compositions, forms and outburst types, including ice-, moraine-, and mixed-barriers. Conversion of outburst floods into debris flows is quite common, usually the more severe risk. For the upper Indus, these are the only types of damaging outburst floods reported in the past several decades. Moreover, they occur whether glaciers are advancing, retreating and relatively stable. Conversely, the larger Karakoram dams involve

All-season avalanches that descend to the surface of Barpu Glacier are the main way ice is nourished. This one falls more than 2000 metres, is two kilometres wide and will travel several kilometres down the glacier. August 2006

impoundment of a main river valley by a relatively large tributary glacier. Most important, in the present context, these dams only form from a vigorous forward push of the ice.

More than 60 glaciers of intermediate-to-large size (10 kilometres to 65 kilometres in length) have a history of advancing into and interfering with

tributaries of the upper Indus and Yarkand rivers. Not all are known to have created actual dams, but at least 30 have done so and involved outburst floods of exceptional size and destructiveness. However, while there have been several large dams recently on the Shaksgam, on the Indus the last major ice dam was in 1933. "Major" refers to outburst floods that were large enough to register hundreds of kilometres downstream at the river gauge at Attock, where the river leaves the mountains.

The most urgent questions today involve some Karakoram valleys whose glaciers created ice dams and catastrophic outburst floods in the past and that are advancing right now. Will they impound the rivers again? Three locations require special attention; the Shaksgam, upper Shyok and Shimshal valleys.

The Shaksgam is a tributary of the upper Yarkand. According to satellite imagery, five glaciers that have formed ice dams in the past are advancing at present. One of them, the Kyagar, has created several recent dams. An outburst from the one in 1999 caused severe damages along the lower Yarkand River in Kashgar district. In the summer of 2009, Kyagar again impounded the river and a 3.5 kilometre-long lake was formed. Fortunately it drained slowly but was close to dimensions that have led to disastrous floods in the past. There were great difficulties in obtaining satellite coverage and scientists were unable to visit the site and monitor the lake so as to predict its behaviour. This raises serious issues about what would have happened if a large outburst had occurred, and what will happen in future cases. It seems a new impoundment will form at Kyagar in 2010, and the four other glaciers are across or entering the river and may impound it.

On the Indus, three glaciers in Shimshal and three on the upper Shyok, that have formed ice dams in the past, began advancing about a decade ago. They have not yet reached positions where a dam could form, but could do so quite soon. Historically, the most dangerous have been the Chong Khumdan and Kitchik Khumdan on the Shyok. In 2009, satellite

Icefalls descending to the main glacier at Kaberi-Kondus Glacier, east-central Karakoram. 1998.

Heavily debris-covered ice, Panmah Glacier Central Karakoram, around 4,000 metres above sea level. Note that even the heaviest debris on active ice is rarely more than 2 metres thick. The relief of mounds and cones is almost entirely ice cored and the debris is constantly shifting around. June 2009.

imagery revealed a sudden and large increase in thickness of the Chong Khumdan, and advance of its terminus into the river. Between 1926 and 1932, this glacier formed a series of large ice dams. At least four outburst floods were reported that caused appreciable rises in the river 1,100 kilometres away at Attock. The 1929 event was the largest on record, and did great damage throughout the mountains and to the Indus Plains. The lake reached over 15 kilometres in length but drained in less than 24 hours. The Kitchik Khumdan also formed large ice dams in the nineteenth century, and its terminus

is back in the river and has advanced across the river which passes beneath the ice. However, 2009 satellite imagery suggests it is beginning to waste back again. Conversely, its immediate neighbour the Aqtash Glacier which has also formed dams in the past advanced across the river in 2008 and 2009 and seems to be advancing very rapidly.

These glaciers highlight problems of security and the legacies of conflicts that exist in many parts of High Asia. They are in a militarised zone disputed by China, India and Pakistan. Apparently the Khumdan glaciers fall under the control of Chinese forces, but the dangers from the outburst floods are primarily in Indian and, especially, Pakistan-controlled areas. Given existing tensions, including the India-Pakistan "war" on the Siachen Glacier nearby, it is unclear how necessary studies, monitoring and warning systems can be set up.

Other hazardous phenomena

The focus here has been on glaciers, but it needs emphasising there is a range of cold climate or cryosphere phenomena that may become hazardous through climate change. Communities, infrastructure and related activities confront changes in snowfall, snow-on-the-ground and permafrost, specifically ground ice. They will also be affected by changes in distribution and intensities of freeze-thaw, the quantities and timing of surface and ground waters and their quality (water temperatures, turbidity and dissolved matter, for instance).

The entire mountain area is covered by seasonal snowfall, varying in duration and depth with elevation. Its melting provides about half of stream flows in an average year. Permafrost – perennially frozen ground – at intermediate altitudes is much more extensive than glaciers and includes hundreds of ice-cored rock glaciers. Freeze-thaw cycles affect even larger areas, as do erosion and deposition forms created by snow avalanches. All of these are affected by climate change. Their responses interact physically,

A series of ice margin lakes along Nobonde Sobande arm of Panmah Glacier, central Karakoram seen from Drenmang (4,500 metres above sea level). Some are behind old lateral moraines, others ponded against the edges of active ice. The glacier is about two kilometres wide here and 10 kilometres of the main ice stream are visible. 1994.

The terminus of Yazghil Glacier, north-west Karakoram, where it enters the Shimshal River. This is one of several Karakoram glaciers on the upper Indus and upper Yarkand Rivers that have caused ice dams and glacier outburst floods in the past, and are presently advancing across the rivers. 1998.

and in ways that modify the scope or significance of glacier-related risks.

Retreating glaciers and warming permafrost are associated with destabilised slopes. They can lead directly to landslides, or reduce the strength thresholds for, and the likelihood or size of, slope

failures due to earthquakes or storms, which trigger most of the more destructive landslide events. For example, a dangerous landslide occurred on January 4, which blocked the Hunza River in the central Karakoram and probably involved destabilisation by changing moisture and temperature conditions in the slopes. The lake has already grown to 5.5 kilometres in length, forcing the evacuation of thousands of residents. Moreover, the lake behind a similar landslide dam in 1858, immediately upstream of the present one, lasted seven months then burst with catastrophic effects all the way to the Indus plains. Meanwhile, slopes exposed by reduced ice or snow cover may dry out and become useless. Conversely, some may also become vegetated and economically useful for timber, firewood, for pastoralists and even for cultivation.

The more immediate glacier hazards and response needs in the region involve communities and activities in the high mountains. Only the Andean highlands rival inner Asia in the numbers and diversity of settlements close to and at direct risk from glacier change. However, for the broader national and international contexts, the major issues raised concern water resources and their reliability.

Some caution is needed here. A commonplace of recent reports is to say that the lives and livelihoods of in excess of 1.5 billion people are critically dependent upon the glaciers in the headwaters of the largest Asian rivers. This is a misleading generalisation. Yes, such are the numbers of people living in river basins with tributaries coming from glacierised mountains. However, in most cases the glaciers are a tiny part of the river flows, notably in the most heavily populated areas of China, India and the south-east Asian mainland.

Snowfall affects much vaster areas than the glacier cover, and is more critical. For the vast majority of these populations, rainfall and ground waters are far more important than snowfall. Glacier change can have impacts on these other parts of the hydrological cycle or may compound changes in them, but

The accumulation zone of Biafo Glacier near Hispar Pass (5,150 metres), showing the development of cornices along ridge lines due to wind action, avalanched steep walls and heavy build up of snow on gentler slopes. June 1999.

High elevation conditions on Karakoram glaciers: rockwalls, ice falls, avalanches of Broad Peak (8,050 metres), part of the watershed of Baltoro Glacier. 2005.

the processes are mostly indirect and too poorly known to make such generalisations. Whether and how far there are significant risks for most of these populations, even from the "disappearing" glaciers' scenario, is far from certain.

The Indus and Yarkand basins do involve large populations directly, or potentially, dependent on the glaciers. Even here, however, there have been exaggerated or misleading claims. Yes, glacier melt waters comprise more than one-third of the flow of the main stem of the Indus, snow and ice together

providing over two-thirds. It has the largest ratio of melt water to population of any river, anywhere in the world. At the moment, however, nearly all the glacial melt water goes to the sea. It happens to coincide with the heavy monsoonal rains, making flooding the greater problem, and Pakistan lacks the capacity to store much or any of the melt waters at that time.

More exactly, the key roles of glacier melt waters have little to do with the total size of the ice cover, total melt water yields, or trends. Rather they turn upon demand in just a few weeks of the year and, in rare, extreme cases when the winter rains or monsoon are very weak, poorly timed, or fail. Even for Pakistan, the main dangers for the country as a whole are, therefore, potential rather than actual, and not so much in relation to glacier change as to planned and possible water resource developments. These seem to be being undertaken with inadequate understanding and assessment of how climate and glacier fluctuations will affect them.

This will become increasingly acute for all countries of the region and raise important transboundary concerns. There are the huge commitments being made now, to hydroelectric power, irrigation, urbanisation and other developments for which water from snow and ice will become increasingly crucial. More than 100 existing dams depend partly on glacial melt waters. Several hundred more, and some of great size, are under construction or planned for China, India, Pakistan, Nepal and Bhutan.

Given the present state of monitoring and scientific understanding, it is hard to believe any of these have adequate or accurate assessments of climate- and glacier-change impacts. For the Karakoram it is of singular concern to determine whether, as global warming continues, there will be a return to glacier retreat as some believe, or if the factors responsible for the present advances will intensify. Either way, there are serious implications for how communities in Pakistan, China and India, especially, are affected and need to respond.

The importance of climate change is not in doubt, but research and policies should be based on actual evidence. Where unavailable, that should be acknowledged, not – as has happened with glacier change in the Karakoram – simply replaced by supposition based on developments or models from elsewhere. Much of what is being said fails to recognise the patchiness of past research in space and time, and a nearly-total absence of glacier monitoring at elevations where the most critical ice and climate changes occur.

The limited evidence surely reflects, in part, the sheer scale, diversity and logistical difficulties of scientific work in much of the region. Now, as more resources become available to investigate these problems, it is important to identify what sorts of information are needed, where and how they can be best obtained. Science and information systems and regional cooperation need to address the complexity and diversity of the greater Himalayan region. Some practical suggestions being promoted by new programmes include the following:

- To set up improved monitoring systems that combine remotely sensed and automatic station measurements with ground control related to basic glaciological and hydrological research;
- To expand comprehensive, multi-disciplinary research that addresses environmental and cultural complexities in the region;
- To pursue regional cooperation in data sharing, risk and resource assessments; and
- To actively involve local communities in the mountains, so that their ecological knowledge and practical concerns inform understanding and help to shape appropriate development.

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Images by Kenneth Hewitt

September 02, 2009

Taking the toad's-eye view

Dipak Gyawali, former water minister of Nepal, explains how to approach Himalayan climate-change science from the grass-roots level. Interview by Isabel Hilton.

Dipak Gyawali is a former minister of water resources in Nepal and research director of the Nepal Water Conservation Foundation. Here he tells chinadialogue editor Isabel Hilton about new research that demands science gets down to the grass roots to help people adapt to climate change in the Himalayan region.

Isabel Hilton (IH): How accurate are predictions of future climate impacts in the region?

Dipak Gyawali (DG): Here is a sense of confusion: the implications of what is happening seem more and more horrendous and some things are pretty certain in terms of the effects. Beyond that, though, the models predict all kinds of things. The question of the Himalayas has not really begun to be addressed and the science has a very long way to go on precipitation and the social effects.

IH: How can science become more relevant to the region?

DG: The effects in different parts of the Himalaya and south Asia will be very different and it's not all about glaciers. The Maldives will be drowned; Sri Lanka may have more tsunamis and more intense storms; Bangladesh will have its own problems. They will not be impacted directly by the glaciers; the interest in the glaciers is that they are powerful indicators: they tell you clearly that something is wrong. It's like going to the doctor with a fever: you know you are sick. But we don't have the kind of science that we need to be able to make accurate predictions of impacts over a hugely diverse region. If you look at the last IPCC [Intergovernmental Panel on Climate Change] report, for instance, the whole of the Himalayas was a blank. People are already suffering but whether we can take any one instance as a directly related with climate change is not certain.

> *"The conventional wisdom is that the most vulnerable people are the poorest of the poor, but we have found that it is actually the lower middle classes."*

We did a series of local consultations from every part of Nepal, bringing farmers together to ask them what they are actually experiencing now as a result of climate change. Many of them cannot relate what they are experiencing to CO2 [carbon dioxide] emissions, and one problem we have is that over a large part of the region is that there is no difference between the word for climate and the word for weather. But when we asked them what is happening to their agriculture, we discovered a whole series of impacts.

Some of them are predictable: spring is coming a week earlier, for instance; things begin to grow, but it is not "real" spring and it can be followed by a blast of terrible cold weather. It seems to be having an impact on cucumbers: they are getting a much higher volume of male flowers to female flowers, so the crop is smaller. The mangoes come into flower and start to grow, but then the fruits shrivel up and drop off, so the mango harvest is shrinking. Lowland pests have

started moving up into the mountains; certain weeds from the lowlands are being found at higher altitudes.

We also looked at some major regional catastrophes, signature events like the failure of the Indian monsoon or the floods in the Terai, to see how people were affected. It's essential to find out what is happening, and we believe we need to rethink development in the light of climate change. That has not happened yet.

IH: Presumably it has not happened because the development agencies have not had this kind of detailed input?

DG: That's precisely the point. The remote sensing and the satellites give us the eagle-eye view, which is essential but not enough. In a country as diverse geographically and socially as Nepal – there are more than 90 languages and 103 caste and ethnic groups – the eagle-eye view needs to be complemented by the view from the ground, what I call "toad's-eye" science.

IH: Because high level science can't be broken down into what is happening in any given local area?

DG: Yes. You are dealing with such diversity: ecological diversity, geographical diversity, cultural and ethnic diversity. The reason that we focussed on this toad's-eye view is that we found that people were not sitting around waiting for an agreement at the COP15 in Copenhagen. Millions are voting with their feet every day at the grass-roots level, reacting with civic science and traditional knowledge. This is what people are basing their everyday decisions on.

There's a real need for high science to come down off its high horse and meet up with civic science and traditional knowledge, in order to understand what is happening, so that national governments can also plan. The high science has to start looking at why there are more male flowers on the cucumbers, why berries are ripening at the wrong time.

Just to take one example: nobody has studied what is happening to soil fauna. Soil fauna are essential to everything and they are one of the first indicators that things are going wrong. They affect everything from plants to birds and nobody knows what is happening with them. Scientists will have to re-orientate themselves, to listen to local people and then to do the work that will make their strategies more robust.

IH: Have you a better idea of who is vulnerable as a result of this work?

DG: Yes. The conventional wisdom is that the most vulnerable people are the poorest of the poor, but we have found that it is actually the lower middle classes. The reason is that the poorest of the poor have never had enough land to keep their families for the whole year, so they have always had to diversify their sources of income: they go and do seasonal labour for part of the year, and they have those networks and connections already. They have a built-in resilience, so if their harvest is worse than usual, they just go and work longer.

The lower middle classes, though, have had enough land to be able to depend on their crops. They might survive one bad year, but two or three wipe them out, and then you get what you are seeing in India – farmers committing suicide. That is also happening in Nepal. The poorest are suffering, but it is not fatal. The people who are really being hit are the lower middle classes and upwards, which has implications for social stability.

IH: What adaptation is possible in these circumstances?

DG: The solutions have to come out of the watershed and out of the problem-shed. You can talk about big solutions – building high dams – which can take 40 years. We don't know in Nepal if a government will last 40 days. The solutions have to be what these millions of households can take. Can they be helped? How can they be helped? We just haven't

done the science for that. We need civic science; ground-level truth.

We have some suggestions for how to do it. At the moment we just don't have the data to model anything at local level. But if, for instance, you put a weather monitoring station in every school in Nepal, and get the children to do the readings and get the schoolmaster to fax the readings back, your data points increase from around 450 to around 4,000. You are suddenly rich in data, and the local people get involved in understanding the dimensions of the problem.

It will be a long, drawn out process, but it is starting with rain gauges in the schools, linked up with the local FM radio stations. Suddenly the FM stations are very excited because they are talking about what is happening in their area instead of reading out a weather report that has come from Kathmandu and might have no relevance at all for them.

We hope our report will point to some things that are essential and some things that local people are already doing in terms of adaptation: building houses on stilts, for instance, so they can move upstairs during the flood season and the people will be safe – their rice will be safe and they can move back down again when the danger is past. Some villages have raised the level of their plinths, just a little bit, but enough to get above the floods.

IH: But won't future floods be much worse?

DG: Not all major floods are caused by high volumes: the Kosi Breach, for instance, happened at a time when the flow was lower than usual. It was the failure of a poorly constructed dam and 3.5 million people were displaced in the state of Bihar, India, and 6,500 in Nepal. If tomorrow the floods get worse, expect more Kosi Breaches. We expect that the intensity and frequency will be greater, but we don't know exactly what is going to happen.

Dipak Gyawali is a former minister of water resources in Nepal and research director of the Nepal Water Conservation Foundation.

Isabel Hilton is editor of chinadialogue.

Image by World Bank

January 19, 2011

Soot strategies

As the power of black carbon to accelerate ice-melt becomes clearer, climate-change policymakers are giving more time to this long overlooked pollutant. Jenny Johnson reports.

> *Estimates are that black carbon may have contributed as much as 50% of the 1.9 degrees Celsius warming in the Arctic since 1890.*

Global efforts to mitigate climate change are beginning to take aim at a once-obscure pollutant called "black carbon" in a shift that may bring policies to cool the planet to families preparing meals at home and farmers readying plots of land for planting.

A series of new scientific studies have confirmed the potent warming effects of black carbon on melting ice and snow in the Arctic and the Himalayas, spurring a new focus on attacking sources of those emissions. The latest research identifies open burning in agricultural fields in Eurasia as a key source of black carbon in the Arctic. Evidence also indicates emissions from the burning of coal, wood and other biomass for domestic cooking and heating throughout Asia are heavily impacting the Himalayas.

Black carbon is part of a chemical mix of particulate matter that has long been an air-pollution concern due to its impacts on human health. But the pollutant also acts to reduce the reflectivity of ice and snow, allowing heat absorption and hastening surface melt. Research indicates reductions could immediately help save ice and snow in the Arctic and the Himalayas, two areas of critical global importance that are proving particularly sensitive to climate change.

Melting of Arctic ice presents several dangers for the planet. The process could undermine the region's ability to act as a cooling mechanism for Earth by reflecting incoming solar radiation back into space and disrupt global ocean circulation by decreasing the salinity of water. Greenland, meanwhile, holds enough frozen water to raise sea levels – if melted – by as much asseven metres. These scenarios are increasingly realistic, as catastrophic loss of ice in the Arctic has accelerated in recent years, well beyond the predictions of climate models.

The Arctic is warming at two to three times the rate of the rest of the planet, with its rising temperatures constituting a possible global "tipping point", which could result in rapid global warming and a cascade of changes through the ecosystem. Black carbon may have contributed as much as 50% of the 1.9 degrees Celsius of warming seen in the region since 1890, according to a 2009 paper published in Nature Geoscience.

Research shows that black carbon is also heavily impacting the glaciers of the Himalayas, another region of global significance. The "third pole" or "Asian water tower" feeds some of the world's biggest rivers, including the Ganges, Yangtze and Yellow River, which together supply drinking water and crop-irrigation for some 1.5 billion people across 10 countries. According to estimates published last year in the journal Atmospheric Chemistry and Physics, black-carbon emissions have caused nearly 10% of the ice-cover loss in the Himalayas from 1990 to 2000, of which about 36% is attributed to Indian coal and biofuel burning.

Previously seen as a distraction from capping and reducing carbon dioxide, the nexus of air pollution and global warming is finally coming to the forefront of the climate-policy debate as evidence grows that so-calledshort-lived climate forcers like black carbon have big effects.

The shift in focus also comes against a background of continuing failure to set credible global policy on carbon-dioxide emissions. Black carbon can be effectively reduced through targeted, regional programmes that can help limit warming in the near term, something that cannot be done with carbon dioxide due to its longer atmospheric lifetime. And black carbon's large and direct human health impacts, plus the fact it is already targeted by rapidly urbanising countries, make it an attractive target.

What next?

The latest research shows that due to a seasonal shift in a climatic anomaly called the Arctic Front, smoke from the widespread open burning of grass and straw that takes place in Eurasia in the late winter and early spring efficiently travels north to the Arctic, where particles from it land on the ice and snow.

Scientists have identified open burning in northern Eurasia – Russia, Kazakhstan, Mongolia and north-west China – as the single biggest source of black carbon in the Arctic and say that, at certain times of the year, it may constitute an even bigger contribution to warming in the region than carbon dioxide.

Sarah Doherty of the University of Washington in the United States used field samples to trace the origins of the black carbon coating snow in the Arctic to biomass burning in Eurasia. At a St Petersburg conference in November, she cautioned that the cooling effects of other particles in the smoke are "highly uncertain" and may dampen the warming impact of black carbon in the region. However, Doherty said that decreasing biomass burning in Eurasia would likely have the biggest single impact on reducing Arctic warming in the near term.

Controlling open burning is a major challenge. Farmers in China and Russia are officially prohibited from disposing of waste, recharging the soil and ridding their fields of pests through burning, but such bans have proved ineffective.

"In order to reduce China's springtime black carbon emissions, farmers need a viable alternative method of crop waste removal," a May 2009 report from US-based non-profit the Clean Air Task Force stated. Researchers are testing ideas for alternatives, such as using straw as a source of bioenergy, which would result in lower emissions. Processing waste for fertiliser is another leading idea.

In Russia, fire policy is coming under the spotlight following the summer's wildfires that burned vast areas of forest amid record heat and drought, destroying 30 villages and killing dozens directly and indirectly from smoke, smog and carbon monoxide effects. While the summer blazes are unlikely to have affected the Arctic on the scale of the spring fires due to climate patterns, critics say the events demonstrated a general lack of capacity on the part of the government to control fires across its large territory. They argue that, without greater capacity, it will be impossible to control the fires in the spring.

Several researchers have reported that the Kremlin is currently reviewing its forest code, which was changed in 2007, doing away with a unified forest protection system and giving more power to the regions. Major changes to the forest code are a top priority for environmental groups in Russia today and there is international pressure on Russian officials to act in time for the next fire season.

Action to decrease the black carbon affecting the Himalayas is more advanced. Several international development programmes are focused on distributing more efficient cooking stoves that greatly reduce emissions. However, the scale of the problem and the expectation that black-carbon emissions will continue to increase alongside Asian industrial development, still hinder effective policy.

The China-based group Third Pole Environment is conducting research into the many unanswered questions about sources and effects of emissions and how the region will respond to global environmental changes and has stressed the need for further work in this area. It is clear that even beginning to address the climate impacts of activities like grass and straw burning in Eurasia will take time. There are many knowledge gaps that prevent robust policy solutions, such as basic data on the types of crops in Russia and its land cover. The willingness of the countries to act remains an open question.

At a supranational level, there is some progress. While black carbon is not among the greenhouse gases addressed under the United Nations Framework Convention on Climate Change, a separate UN convention is set to begin shaping reduction policies to mitigate climate change. In December, the Convention on Long-range Transboundary Air Pollution (under the UN Economic Commission for Europe) agreed to revise one of its protocols in 2011 to include black carbon, as well as other short-lived climate forcers, such as carbon monoxide and methane.

This step will make it the first international body to begin shaping policies that account for the air pollutant's climate effects. Europe, the United States and Russia are among signatories to the convention. China is not, but the work plan for the coming year specifies the creation of policies that could be applied outside the area currently covered by the convention.

A series of new studies on black-carbon sources, effects and mitigation options are set to be published in 2011 by the United Nations and several high-profile research institutions. As understanding of the issue improves, advocates are hoping united solutions and action will quickly follow.

Jenny Johnson is a journalist based in St Petersburg, Russia.

Image by nick_russill

Part 3:
Dams and hazards

The Himalayas – formed from the clash of two great tectonic plates – is one of the world's most active earthquake zones. With its powerful rivers and deep valleys, it is also extremely attractive to dam builders. The governments of the region have dramatic plans to transform the Himalayan rivers into the powerhouse of South Asia, ignoring the potential hazards and the cumulative and transboundary impacts of such projects.

In this section, Ann-Kathrin Schneider argues that climate change poses unprecedented challenges to hydropower development in the region and calls for a comprehensive review of dam building projects. Meng Si discusses the impending hydropower boom in western China. Zhou Wei gives voice to Chinese scientists' concerns about a radical proposal to divert Tibet's water. Daanish Mustafa and David Wrathall call for a new approach to river basin management in the wake of the destructive Indus flood of 2010. And Joydeep Gupta debunks an old myth that dam building in Nepal can prevent floods in India's Ganges basin.

Dams and hazards
Contents

February 23, 2009

Mountains of concrete?

The effects of climate change on the Himalayan glaciers pose unprecedented challenges to hydropower development in the region, writes Ann-Kathrin Schneider.

The warming climate is changing the environment in the Himalayas faster than any other region of the world. The mighty glaciers of the world's highest mountains – the source of most large Asian rivers, including the Indus, the Ganges and the Nu (Salween) – are melting.

Against these dramatic changes, the governments of India, Pakistan, Nepal and Bhutan are planning to transform the Himalayan rivers into the powerhouse of south Asia. They want to build hundreds of mega-dams to generate electricity from the wild waters of the Himalayas. With over 150,000 megawatts (MW) of additional hydropower capacity proposed in the next 20 years across the four countries, the Himalayan region could potentially have the highest concentration of dams in the world.

While a high concentration of large dams will challenge the integrity of river basins and the livelihoods that depend on them, a dam building boom in the Himalayas could have a range of unforeseen consequences due to climate change.

Global warming will cause glaciers to melt, river waters to rise and increase the risks of storms and floods. The water situation in the Himalayas will change drastically: past seasonal and regional trends will no longer be a good measure to predict future water flows; these flows will change in each and every Himalayan river.

What does this mean for dam building in the region? When planning hydropower projects, some of the most crucial data is about river flow. However, with melting glaciers in the Himalayas, historical river flows are no longer a good measure for future flows. Climate change has destroyed the certainty that future river flows will be similar to past flows.

> *Climate change has destroyed the certainty that future river flows will be similar to past flows. This uncertainty makes it incredibly risky to build dams.*

This uncertainty makes it incredibly risky to build dams. The extent of the predicted storms is not known, the seasonal distribution of waters is no longer certain. Nobody can predict when the waters in the rivers will rise, how much they will rise and for how long. Moreover, no one knows when the glaciers will eventually have melted – and no longer can provide any water to the rivers at all. We only know that the melting of the glaciers in the Himalayas will result in an initial increase and then a decline of water flows in the Himalayan rivers.

The data needed to build hydropower projects in the Himalayas is not available. It is not clear how often the dam gates of any planned dam in the Himalayas will have to be left open in order to allow for extremely high floods to rush through its gates (all the while not generating any power). Storms, strong rains and floods, which are predicted to increase with the warming climate, can also threaten the very existence

of dam walls and can destroy even the most robust mountains of concrete planned in the Himalayas.

Shripad Dharmadhikary, in his report "Mountains of Concrete: Dam Building in the Himalayas", has shown that the plans for most dams in the Himalayan region do not take the likely impacts of climate change on the Himalayan rivers into account. Dharmadhikary says: "Unfortunately, none of these risks are being considered in the dams planned for the Himalayas – neither for individual dams, nor cumulatively".

The governments of the region, eager to make the dam-building boom happen, focus on the expected benefits while turning a blind eye to the uncertainties of global warming. "Hydro-dollars" are on the minds of the governments of Nepal and Bhutan, who want to build the large dams to earn revenues from the sale of electricity to India. India itself is eager not only to buy hydropower from its neighbours, but also to generate it in the mountainous regions of the country.

Nepal currently finds itself in a severe energy crisis, with a shortage of petroleum fuels and only 40% of the rural population with access to electricity. However, most of the large dams in the country are planned for the export of electricity to India. Among the big projects planned for the immediate future, West Seti, Upper Karnali and Arun III are all meant to sell electricity to India, with only a small percentage of that power being set aside for Nepal.

It comes as no surprise that these large dams face opposition from the residents they will displace. But some in Nepal also explain that the country will not even gain "hydro-dollars" from projects such as West Seti. Ratna Sansar Shresthar, a Nepali lawyer and financial analyst, explained that since the project is being built by foreign corporations, Nepal will not see much of the expected profits. "Since most of the project's equity comes from overseas – except for the government's 15% share – only 15% of the dividend will come to Nepal," said Shresthar. "Another major outlay is the repayment of a part of the principal and interest. As the project is borrowing from foreign agencies, these payments will never enter Nepal." The promises of high revenues for Nepal are therefore likely to remain unfulfilled.

In India, the basic driver for hydropower is the demand for electricity. The country continues to be plagued by power and energy shortages. Overall, peak power demand over 2007 was 108,886 MW, of which only 90,793 MW were met – a shortfall of over 16%.

Moreover, a large portion of the Indian society does still not have access to electricity. The government says that in 2006, one in four Indian villages was still without access to electricity.

However, it is not clear that a lack of access to electricity can be blamed solely on the country's lack of generation capacity. India's electricity grid is known for its huge transmission and distribution losses of between 35% and 45%. Recent increases in electricity costs for private consumers, as well as the reduction of subsidies, have further reduced poor people's access to the grid.

More hydropower capacity will not necessarily increase people's access to electricity. Since most of the projects are planned at high altitudes, they will be costly and so will the electricity that they generate.

The 4,500-MW Diamer-Bhasha Dam on the Indus in Pakistan, with a price tag of US$12.6 billion, is the most costly dam planned for the Himalayan region. While the government of Pakistan has been working for more than two years to find funders for the project, its finances are still on shaky grounds. In November 2008, Pakistan's National Economic Council approved US$1.5 billion toward the construction of the dam, and Pakistan's minister for water and power declared that Chinese companies would build the dam and "some Arab countries" would provide part of the financing. Around the same time, the World Bank refused to provide any funding for the project, dealing a severe blow to the government's attempts to find foreign backers. In response to this decision, the minister was quoted as saying that several alternative avenues for funding the project would have to be

sought, including private sector loans and a surcharge on electricity.

The Diamer-Bhasha Dam is not the only project that lacks clear funding commitments and forces the government to try to find alternatives to traditional funders that used to provide the bulk of the funds for hydropower.

In India, traditional funders are also taking a back seat and Indian financial institutions, as well as Indian public sources, are playing larger roles. But the financial gap is still huge; with the current global financial crisis, the appetite for funding large dams might be further diminished. Dharmadhikary shows in his report that over 40% of the funds needed for the Indian government's Eleventh Five-Year Plan for the power sector are still lacking.

Global warming might be the most serious challenge to the safety and efficiency of the proposed dams in the Himalayan region, but the funding gap appears to be hampering India and Pakistan moving ahead with the largest planned dams for the region, including the Diamer-Bhasha project. It also appears that strong local opposition to some of the major projects, including the West Seti project and the 3,000-MW Dibang project in Arunachal Pradesh, India, constitute larger obstacles for the project planners than anticipated. Planned public hearings for the Dibang project have had to be cancelled several times due to strong opposition, and the government of Sikkim has announced it will scrap four planned projects on the Teesta River, in response to local opposition.

Opposition to the projects testifies the low degree of participation of affected people in the relevant decision-making processes – and the lack of consideration for the social and environmental impacts of the planned dams. Dharmadhikary's analysis also testifies to the lack of consideration for climate-change issues in the planning processes. He writes: "Pushing ahead such a massive dam-building program in the fragile Himalayan region without proper social and environmental assessments and safeguards, and ignoring the likely impacts of climate change, can have severe consequences.

"All of these things point to the need for a comprehensive review of the dam building program in each of the river basins in the Himalayas."

Ann-Kathrin Schneider is South Asia programme director and policy analyst at International Rivers. Schneider holds a Master's degree in Development Studies from the School of Oriental and African Studies in London. Her work focuses on monitoring and challenging the activities of international financial institutions such as the World Bank and private banks.

Image by International Rivers

February 14, 2011

Hydropower's green excuse

Seven years ago, public pressure brought plans to dam China's Nu River to a halt. But top officials, bolstered by clean-energy targets, are backing the scheme once again, reports Meng Si.

"Hydropower development is a must," said a senior official from China's top economic planners, the National Development and Reform Commission (NDRC), effectively breaking seven years of silence on hydropower exploitation on the Nu River – China's last great waterway without large-scale dams – and dashing the hopes of campaigners who successfully halted development in 2004, after a public outcry.

Feeling the pressure from energy-efficiency and emissions-reduction targets in China's 12th Five-Year Plan, due to be published next month, the government and state-owned electricity enterprises are ramping up their hydropower ambitions. Bets are rising on a "Great Leap" in hydropower exploitation.

On January 28, Shi Lishan, deputy head of the New Energy and Renewable Energy Division of China's National Energy Administration, set out his views on the Nu River (also known as the Salween): "My belief is that development is a must. Because the Nu's upper and lower reaches are already built up, in the past some people have said that it is necessary to leave a stretch of free-flowing river. I believe that putting that theory into practice is not realistic.

"We expect that, on the basis of strong evidence, and after seeking the opinions of all parties, that we can press ahead with hydropower construction on the Nu River."

A journalist who has long reported on hydropower issues in China is Liu Jianqiang, chinadialogue's Beijing editor. He believes that hydropower development has caused so much controversy in the past in China because of the negative impact on ecology and displaced people – but that now hydro interest groups are using the need for energy and emissions saving as an excuse to promote a new round of frenzied hydropower development.

> *"Hydro interest groups are using the need for energy and emissions saving as an excuse to promote a new round of frenzied hydropower development."*

In 2004, under pressure from environmental groups and the media, the prime minister, Wen Jiabao wrote in the State Reform and Development Commission report on the Nu River hydropower development project that "given the high level of social and environmental concerns over the large scale hydro project, further careful research is required in order to reach a scientific decision".

In the years following this event, the hydropower developers on the Nu kept a low profile, studiously avoiding doing anything to draw public attention. But the high-sounding sentiments from authorities in recent weeks have led Chinese NGOs to believe this time, the problem is serious.

The Nu is one of south-west China's great rivers, starting high up on the Qinghai-Tibetan plateau and flowing down to the Indian Ocean. Its water resources

are rich and it is currently China's only large river without any large-scale dams.

According to the first plan for dam construction on the Nu, a string of 13 hydropower stations would produce annual output of 102.96 billion kilowatt hours. When completed, the value of the electricity generated could reach 36 billion yuan. Every year, it would generate 8 billion yuan in tax revenue for the government and local government coffers would also grow by 2.7 billion yuan.

"It's true that hydropower exploitation can bring economic development, but not necessarily to the benefit of local people," says Ma Jun, director of Chinese NGO the Institute of Public and Environmental Affairs (IPE). He believes that today's insufficiently transparent policymaking mechanisms are maximising the interests of hydropower industry, officials and a small number of experts, while driving ecological destruction, affecting local livelihoods and increasing the risk of geological disasters.

Back in 2003 and 2004, proposals to build a string of dams on the Nu River provoked a fierce debate. A journalist from China Economic Times reported seeing a report on a meeting to assess hydropower projects on the middle and lower Nu, which said: "Hydropower development on Nu river is unstoppable. Preparatory work of next stage will be carried out as soon as the state approves."

Today's "hydropower is a must" has something of the flavour of that report's "unstoppable". But, back then, central government ultimately backed the voice of the people. Today's government is more worried about how "clean" hydropower energy can help the government fulfil its low-carbon promises.

The Chinese government has committed, by 2020, to getting 15% of its power from renewable sources. By 2020, it is also bound to reduce the carbon-intensity of its emissions by 40% to 45%, based on 2005 levels. However, to hit the energy-saving and emissions-cutting targets in the 11th Five Year Plan period, electricity supplies were cut off in some places. And, in the first half of 2010, energy consumption per unit of GDP jumped, showing just how difficult it will be for China to achieve the energy targets.

At the end of 2010, Zhang Boting, vice secretary of the China Society for Hydropower Engineering, told reporters that the 12th Five Year Plan called for hydropower development to be prioritised. For various reasons, two thirds of the hydropower projects detailed in the 11th Five Year Plan had not been completed and would be revived in the 12th Five Year Plan.

In November last year, the waters of the Yarlung Zangbo (which becomes the Brahmaputra downstream) were dammed for the first time as part of a project to build Tibet's first large-scale hydropower station, at Zangmu. Immediately afterwards, the developers commenced the plant's main construction stage. Geologist Yang Yong told Southern Weekend that this event marked the "start of a hydropower age in Tibet". Four of China's "big five" electricity companies have already made their way into the region.

It is not only the future of the Nu River that is at stake. In January 2011, in order to boost hydropower construction, a proposal was submitted to shrink a reserve for rare fish on the upper reaches of the Yangtze River, threatening the existence of many species. At the end of 2010, China's oldest environmental NGO, Friends of Nature, requested a public meeting with the environmental authorities, but their request was denied.

In the past, the Ludila, Jinanqiao, Long Kaikou and other hydropower projects were stalled due to obstruction by environmental groups and the pressure of public opinion. But now, one by one, the embargo on these projects has been lifted.

Ma Jun says: "Environmental groups are not completely against dams. We approve of appropriate development. But China's present speed of

development is excessive." He says that, by 2004, China had overtaken the US to become the country with the world's largest hydropower capacity. At that time, the target was to reach a capacity of 300GW, equivalent of tripling capacity within 16 years. After another 15 years, China's hydropower resources will reach their limit. "Now there is no way to undo the destruction and this will becomes a historic regret," he says.

Ma Jun says that if hydropower exploitation on Nu River gets going again, it will very likely trigger a new wave of high energy-consuming industrial development in south-west China, due to local government plans to use the newly generated electricity to exploit the area's rich mineral resource. This is difficult to square with the national goal of low-carbon development.

Ma Jun's research shows that in many areas of Yunnan province, to adjust the unstable electricity generated from hydropower, coal-fired power plants of the same scale are built up as back up. The Nu River could face the same situation, given its unstable water flow in different seasons. And this is difficult to square with national goals on low-carbon development.

The National People's Congress (NPC) and Chinese People's Political Consultative Conference (CPPCC) – two top government bodies – will meet in March this year. And the elements of the 12th Five Year Plan concerning energy efficiency, emission reduction and hydropower exploitation will be at the heart of their discussions. At the same time, Friends of Nature has been calling on local green groups to write open letters to NPC and CPPCC representatives, urging them to reconsider plans to shrink the national-level nature reserves on the upper Yangtze River.

Meng Si is a Beijing-based freelance journalist who formerly worked at chinadialogue.

Image by SunnyBada

September 20, 2011

Divided waters in China

Chinese scientists troubled by radical proposals to divert Tibet's water are making their voices heard. Zhou Wei listened in at a seminar about the Shuotian Canal.

One of the boldest engineering concepts to emerge in China in recent years is a plan to "save" the country by transferring water from Tibet to the parched north. Among the schemes put forward, bringing water from Shuomatan point in Tibet to the city of Tianjin on China's east coast – the "Shuotian Canal" – has received particular attention. It is said to have the backing of military figures and academics, but at a seminar last month scientists from a number of different disciplines were merciless in their criticism of the scheme.

The early August gathering, organised by Chinese NGO Green Earth Volunteers, brought together experts in geology, meteorology and wetlands conservation with the man behind the proposal, Guo Kai. Guo is convinced the Yarlung Zangbo River (known as the Brahmaputra once it crosses the border into India) is the solution to water shortages in some of China's driest parts. (See chinadialogue article "Diversion debate" for more detail on proposed water transfer schemes from western China.)

Sometimes referred to as a modern day Guo Shoujing, a Yuan Dynasty water expert, Guo Kai comes from a family of hydraulic engineers and is a retired technical cadre. His business card lists a number of titles: originator and chief designer of the Shuotian Canal, author, professor, economist, vice-director and secretary of the Shuotian Canal Preparatory Committee and chairman of the Beijing Shuotian Consulting Development Company.

Guo explained that he originally planned to bring water from the Yellow River to Beijing – but then the Yellow River dried up. He also thought about the Yangtze River, but its western reaches didn't hold enough water either. "But the Brahmaputra has plenty of water; it won't make any difference to India," he said.

> *"Even shouting can cause an avalanche in these steep snowy valleys, said Xu, let alone the blasting, artificial landslides, dyke-building and river-blocking required by the Shuotian scheme."*

Promotional material from the Shuotian Canal Preparatory Committee shows the canal cutting across China from west to east, crossing five different rivers on its journey from the Brahmaputra to the north-east and requiring construction of 10 separate reservoirs. Were it to go ahead, on its way to the Yellow River the canal would take water to more than 14 provinces and municipalities in the west and north of China, including Qinghai, Gansu, Inner Mongolia, Xinjiang and Beijing – and generate electricity en route. The proposal claims the canal would in one fell swoop solve China's shortages of water, electricity, grain and oil, relieve pollution and even ease the rural-urban wealth gap. Examples of support from senior levels of government over the years are also provided.

Before the seminar, Xu Daoyi, a retired researcher from China Earthquake Administration's Institute of Geology had scrutinised the book How China will Save the World, published this year, which sets out the case for Guo Kai's scheme. Xu pointed out that the proposal barely touches on the seismic and environmental risks, even though the canal would cross several earthquake-prone areas. Its tunnels would also pass through the high mountains of the south west, where devastating landslides are possible. There is no way to route the project without passing through these geologically unstable areas.

Xu listed 10 major earthquakes that have struck the south-west over the last 60 years. Pointing to a table of earthquake data, he asked Guo Kai: "What impact will an earthquake have on your canal? You don't seem to have thought about that. If one of your tunnels collapses, what then?" Xu pointed out that reconstruction following an earthquake could be more expensive than the original build.

Even shouting too loudly can cause an avalanche in these steep snowy valleys, continued Xu, let alone the blasting, artificial landslides, dyke-building and river-blocking required by the Shuotian scheme. The map of the proposed canal also indicates that Qinghai Lake will be used as a reservoir – but it is a saltwater lake. The proposal says salinity will be reduced by the water from the canal, when in fact the water of the canal will become salty, argued Xu. The proposal is poorly thought through, he concluded: if the Shuotian team really wants to do this, then they should be prepared to do the necessary scientific research.

Chen Kelin, head of Wetlands International's Beijing office, expressed concern about protecting wetlands on the Tibetan Plateau. The Yellow River dries up almost every year now – in 1999, the dry patch continued for more than seven months – and the ground in many areas along its banks has become salty, he said. The 490,000-hectare Zoige wetland on the upper reaches of the Yellow River has plenty of capacity to store water, but is suffering from over-grazing, pest infestations and the impacts of mining, all man-made issues. "If we looked after it properly, there wouldn't be any need for wasteful water-transfer projects," said Chen.

In his speech, Guo Kai described the Tibetan Plateau as an area of permafrost, with huge quantities of water resources in the form of ice – as the climate warms and that ice melts, that water should be used, he said. Meanwhile, the Shuotian team's solution to Chen Kelin's concerns about the Zoige Wetlands was another water transfer scheme: "bringing in water from Sichuan's Dadu River".

But Guo Kai's arguments received short shrift from the assembled scientists. Tao Zuyu, a retired professor from Peking University's Department of Atmospheric Physics, was next to jump in. He started by criticising the map the Shuotian Canal team had provided to the seminar's participants: beautifully made, with a detailed explanation of the project in the back, but lacking scale or contour lines, it looked more like a tourist map than a scientific document, making the project seem like a mere fantasy, he said.

We're all entitled to our dreams, Tao said, but if you want to turn dreams into reality, you have to put the work in. How much water is there to transfer, and will moving it change the climate? Desert formation is linked to atmospheric circulation, which in turn is connected the layout of the land and ocean, he said – the implications need to be worked through.

Geologist Yang Yong has been researching water diversion in western China for the past four years. He had four major concerns: first, he said, there is still vigorous debate over the risk of triggering earthquakes and geological disasters on the Tibetan Plateau with such schemes. Second, the points identified for water diversion into the Shuotian Canal would not actually be able to supply the quantity of water claimed in the proposal. Third, the canal would change the entire distribution of water across China, particularly in the south-west: there are already many hydropower stations in this region, but the transfer and damming of rivers for the Shuotian Canal would

result in existing dams and power stations lying idle: a massive waste.

Finally, Yang questioned whether the project had the necessary mechanisms and systems to respond to situations such as drought, or climatic changes caused by the scheme, as well as earthquakes and mudslides. He pointed out that China's water authorities had previously proved themselves to be slow or incapable of reacting adequately to drought in the south-west.

Tao Zuyu urged the Shuotian team to take heed of international lessons: the former Soviet Union once transferred water to Kazakhstan, but ended up turning the local soil salty. The colonisers of America planted grain on land once used for grazing – and caused desertification. "We must respect nature," Tao said.

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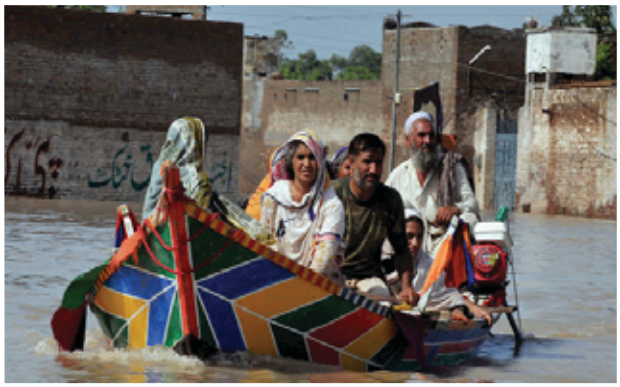
Image by Nasa Images

March 11, 2011

Lessons from the flood

Human error played a key role in last year's devastating floods in Pakistan, write Daanish Mustafa and David Wrathall. They call for a new approach to the Indus basin.



Editor's introduction: *In July and August 2010, abnormally heavy monsoon floods hit the Indus River in Pakistan, causing unprecedented damage. The floods deluged a fifth of the country, affecting 21 million people and destroying homes, farmland, health clinics, power stations, schools, roads and water-supply systems. The scale and damage of the floods is greater than that of the Asian Tsunami, the Kashmir earthquake and the Haiti earthquake combined.*

The government deployed at least 20,000 troops to lead rescue operations, while its civilian officials attempted to distribute cash handouts to flood-affected people. However, in a country prone to disasters, and where extreme weather patterns such as the current floods are becoming more and more frequent, the state should have been better prepared to deliver a response.

Pakistan and the international community will have to learn lessons from this disaster. Was it natural or man-made? What kind of flood management will help prevent or mitigate future floods? Why did the brunt of the impact fall on the poorest people?

Daanish Mustafa, a water expert from Pakistan who teaches at King's College in London, explores the causes of the current disaster and draws on the lessons that can be learnt. He argues that mismanagement of river systems by building dams and embankments along the Indus has major long-term costs. A new paradigm of water management that adjusts to the natural rhythms of the river, rather than vain attempts to control and harness its water is required.

This is not the first disaster that Pakistan has experienced and it will not be the last. But the crisis can be used strategically to build better and to address the problematic social and physical factors that contributed to the disaster in the first place. The central government's current approach of cutting development budgets in half and focusing on the cash disbursement scheme will leave many underlying issues unresolved.

> *Pakistani water managers have kept a sharp eye on the benefits that they could extract from the Indus basin rivers, without regard for the hazards.*

Pakistan's great Indus flood of 2010, and the unprecedented devastation it caused, cannot be understood or mitigated against in isolation from the "routine" river management in the Indus basin. The cultural, economic and social geographies of water use, distribution and regulation in the basin are integral links in the causal chain of events that led to the disaster. The disaster therefore is deeply human in its genesis, even to the extent that the irregular monsoonal pattern that triggered the floods may be linked to anthropogenic climate change. After all, the weather anomaly observed in 2010 has recurred in a milder form about three times in the past decade – in the previous century, it was seen once every 10 years.

We hope that this article will serve as an invitation to Pakistani water managers and their colleagues globally

to critically re-evaluate their basic assumptions and procedures for river management and perhaps lead to greater integration of flood hazard and issues of social vulnerability in water-resources management. Vulnerability here is understood as a socially determined state of being, where people are more likely to suffer damage from an environmental extreme and are less able to recover from those extremes.

Last year's floods have been declared to be the worst calamity to have hit Pakistan in its history – and the world in the twenty-first century. Although the death toll of more than 1,700 lives at the time of writing this article is relatively modest in comparison with other disasters such as the Asian Tsunami, the Kashmir earthquake or the Haiti earthquake, the scale of inundation and the material damage from the floods seem to be greater in scale than the three major disasters of the twenty-first century combined. Furthermore, with stagnant water in inundation zones a major disease vector, the final indirect toll – especially on children and the elderly – is likely much higher.

Our core argument is that the Pakistani water managers have kept a sharp eye on the benefits that they could extract from the Indus basin rivers, without regard for the hazards that are also integral to living in river basins. Pakistanis – as the proverbial Faustus – bargained with the devil of technocratic vanity to pretend that they could ignore the river system's natural rhythms in return for the agricultural productivity and prosperity (for some) that it could deliver. The gains from the river have been realised: now it is time to pay the price.

Approaching the river with a view to controlling and taming it is bound to fail. A better tactic would be to learn to adapt to the Indus basin's hydro-meteorological regime, particularly in view of the looming uncertainties from climate change. An adaptive flood strategy will not only involve different behaviour towards the physical system but also towards the social systems that depend on it. Greater attention to issues of differential vulnerability to floods, and equity in distribution of the irrigation system's benefits will be an integral part of a resilient adaptive flood-management strategy.

Last year's flooding stems from a confluence of events possibly associated with a warming planet. In July, when monsoon rain began in Pakistan, 2010 was already the hottest year on record and high glacier runoff had already filled rivers to capacity. Evaporation rates over the hotter-than-average Indian Ocean soared, leading to especially active monsoon weather, and oceanic phenomenon La Niña is thought to have exacerbated the severity of monsoon activity. As Michael Blackburn from the United Kingdom's University of Reading explains, both the fires in Russia and the precipitation activity in Pakistan were globally linked through an unusually strong polar jet stream, which stalled unprecedented levels of moisture over the Himalayas, pouring into the Indus valley a quantity of water equivalent to the entire land mass of the United Kingdom.

Although evidence of climatic changes cannot be deduced from a single meteorological event; nevertheless, the number of exceptionally heavy monsoons over India has doubled in the last 50 years, while at the same time moderate and weak precipitation has decreased. South Asia is becoming more arid during dry seasons, and wetter during monsoons. In the Arabian Sea, data from the 1880s to the present indicate that in past decades severe cyclonic events have increased three-fold during intense cyclone months. In the past 15 years, Pakistan has directly received four considerable low pressure cyclonic systems, of similar orders of magnitude to this year's, in 1993, 1999, 2004 and 2007, as well as other lesser systems in 1998 and 2001. Weather variability like we have witnessed this year may be part of long term trends for the Arabian Sea.

By July 22 last year, record levels of rainfall had begun falling across Punjab, Khyber Pakhtunkhwa and Balochistan. Tens of thousands were displaced

immediately, and up to a million more in the following week as flash flooding surged through riverbeds and canals. Flooding started along major tributaries, overwhelmed flood barriers and spread through canals, generally overwhelmed water-management capacity, and eventually inundated large swaths of farmland.

By early August, flooding had reached the lower Indus valley and red alerts were announced for Sindh and Balochistan provinces. According to Pakistan's National Disaster Management Authority, one fifth of the entire area of Pakistan was submerged at the high water mark, affecting 84 out of 121 districts. By August 31, Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan provinces along the Indus river valley were still flooded, and some 800,000 people were still physically cut off. Some levee surfaces, already saturated for nearly a month, began to deteriorate and burst, which exacerbated the crisis in several notable instances, as in the case of historic Thatta city, where 95% of the population – some 170,000 persons – were displaced.

By the first day of September, though the rain had largely ceased, contaminated flood waters continued to rise in the southern provinces, and roughly one million people in Sindh province alone were in the process of migrating away from submerged villages to higher ground, urban areas and Internally displaced person (IDP) camps. While some of the flooding was caused by the overwhelming of levees and flood barriers, a considerable amount was the result of deliberate breaching of the embankments by irrigation authorities to keep regulatory infrastructure from suffering damage. This has been a cause of considerable controversy in the country.

Around 21 million people have been affected; at least 1,700 people had perished due to flooding – probably more; and 1.8 million homes destroyed or damaged. According to the World Health Organization, 10 million people have been left with unsafe drinking water, a figure that will likely increase as time goes on, increasing the potential spread of water- and vector-borne diseases. From mid-August, cholera outbreaks were confirmed, raising the alarm of a secondary health crisis.

The floods affected 17 million acres of Pakistan's most fertile land, causing total damages estimated at over US$7 billion (47 billion yuan) with US$2.9 billion (19.26 billion yuan) to the agricultural sector and US$4 billion (26.6 billion yuan) to infrastructure. With agricultural production decimated, food-distribution systems disrupted, food prices spiking and household economies in tatters, the spectre of food insecurity is beginning to take physical shape. With 3.6 million hectares ruined, the results of winter wheat crop for 2011 are uncertain. Food shortages in the event of a below par wheat crop could further destabilise some of the most affected areas of the country.

Certainly, the brunt of the impacts has been borne by the most vulnerable and impoverished areas. For example, 90% of the 1.7 million refugees fleeing strife in Afghanistan currently reside in flood affected districts. These are people already at the margins of society. With farmland trapped beneath water and silt, and at least 1.2 million livestock dead, small-scale and subsistence agriculturalists and cattle herders are least able to cope with impacts. According to earlier research on flood hazard in Pakistan, livestock is a key asset used for recovery in the aftermath of floods, and the losses are likely to stretch the Pakistani rural livelihood and recovery systems to the limits.

According to the International Monetary Fund (IMF), the total economic cost of flooding to rural livelihoods, agricultural output, industrial input and infrastructure, including lost economic productivity, is expected to totalUS$43 billion (286 billion yuan), raising the possibility of financial insolvency. Already deeply indebted, Pakistan will have to make tradeoffs in order to recover from impacts, and inevitably discussions will occur around scaling back essential social services, including education, rural healthcare and poverty-reduction programmes. As government priorities drift toward flood response, rehabilitation

and reconstruction, many expect illusive development goals to slip still farther away.

The relationship between anthropogenic environmental degradation and catastrophic flooding in Asia, Latin America, Europe and other regions is well documented. Conversely, we know there is an established link between healthy watersheds with flow capacity – wetlands, marshes, estuaries and mangroves – and flood mitigation. Since disasters have been shown to be costly to long-term development goals, questions are raised about need to invest in risk reduction, and with the rising challenges of climate change, we must ask ourselves: can our engineered systems keep pace with climatic trends?

Past failures of flood control

Pakistan benefits from an extraordinary water supply, sourced mainly from swift-flowing glacial melt from the Himalayas in late spring, and monsoon activity between June and October. To take advantage of this tremendous resource, the country has been highly engineered in hydrological terms: irrigated areas represent 82% of all farmland and 43% of the 170 million-strong population is directly dependent on farming activities. However, irrigated areas are exposed to flooding hazards, and consequently the largest sector of the economy and the majority of Pakistanis are vulnerable.

> *"There are accusations in the Pakistani press that, in fact, some of the levees were breached to protect the lands of specific influential interests."*

Additionally, many villages are situated on river terraces, or in low-lands, and urban migrants tend to informally settle in low-lying high risk areas. As the great flood of 2010 has illustrated in vivid detail, floods are typical in the five major rivers of the Indus River Basin. Twenty major floods, and many more minor floods, occurred in the 50 years from independence in 1947 to 1997. Thus Pakistan is exposed, susceptible and sensitive to regularly occurring flooding events which at times are exacerbated by the river engineering necessary to maintain the irrigation infrastructure.

The development of Pakistan's flood-management system can be characterised by two dominating approaches and two corresponding periods: 1947 to 1973, a period of risk acceptance and limited risk management; and 1973 to the present, a period of comprehensive physical risk management. Although flood-irrigation techniques – where water is distributed across the soil by gravity – had dominated farming along the Indus River since pre-historic times, the original canal network, upon which the current system is based, was conceived and executed under British colonial rule, beginning with the Upper Bari Doab Canal in 1859. Throughout the colonial era, the system was maintained and expanded, such that, on the eve of independence, there were 150 major canals extending thousands of kilometres through the country.

The colonial approach to flood management depended on a network of "bunds" (linear levees along rivers and ring levees around cities), which the army could strategically breach when waters approached flood stage. During periods of high water, barrages and cities with bunds were protected, but massive flooding would occur in breach areas and regions without protection. The general public had little influence on flood management, though public opinion in affected areas fell decidedly against risk acceptance. The bund system of flood management was carried forward after independence.

In 1960, the Indus Basin Development Programme (IBDP), a colossal engineering project signed into existence with the Indus Waters Treaty between India and Pakistan, further fashioned much of Pakistan's countryside into an extensive network of canals and reservoirs. The focus of flood planning – shaped through the lens of the Indus Waters Treaty – was

on drainage procedures to avoid damage to recently constructed critical infrastructure.

The IDBP was part of a wider trend in modern flood management, born out of the experiences of inundations that beset the Tennessee Valley and the Great Plains of the United States early in the twentieth century. Armed with the vanity of modern engineering techniques and the doctrine of economic growth, international financial institutions and donor countries began to promote and incentivise mega-projects, like the IDBP in Pakistan and the Helmand-Arghandab Valley Project in neighbouring Afghanistan, offering enormous loans to developing countries. This international one-size-fits-all engineering approach to hydrological mega-project spread to developing countries around the globe, in spite of important regional peculiarities.

These water projects, while credited for transforming developing countries into the world's producers and exporters of commodities like wheat and cotton, are also widely criticised for their environmental impacts. Biodiversity plummets in the face of habitat destruction, soil erosion increases, grazing land disappears and water-borne disease proliferates. In addition, the changing nature of river aggradation and erosion processes can result in accentuated flood events. Some of these consequences in the case of the Indus were even recognised under the British Colonial administration – but were generally considered to be the price of development.

Questions also arise about the relevance of large-scale projects to goals of poverty reduction. Engineering projects can exclude and marginalise the vulnerable poor, whose livelihoods are already sensitive to shocks. So much of rural, subsistence agriculture in developing countries is based on flood recession irrigation. Famous examples from Africa, both the Kainji Dam in Nigeria and the dams on the Lower Omo River in Ethiopia, have resulted in massive disruptions to flood recession agriculture livelihoods, on which hundreds of thousands of vulnerable poor depend.

Moreover, developing countries like Pakistan, whose rural livelihood systems, infrastructure and economies are utterly transformed by these projects, suddenly become vulnerable not only to flooding events but also to fluctuations and shocks in international commodity markets. Market-led growth in the absence of social programmes has another consequence: growing disparity between the haves and have-nots, who incidentally became the most vulnerable to river flooding.

Upon completion of IBDP in 1970, Pakistan's agricultural production expanded substantially. However, shortly thereafter, in 1973, when massive flooding generally overwhelmed the canal network, the risk-management paradigm shifted. Vulnerability of the system was revealed, as well as the resource and experiential constraints of regional flood managers in dealing with newly engineered canals and reservoirs.

In 1978, the Federal Flood Commission was established to implement a comprehensive risk-management strategy, the National Flood Protection Plan. The tool kit of the new strategy included greater resources for reservoir operations, including procedures, inspections and training; schedules for bund maintenance and reinforcement and bund breaching plans; expansion and modernisation of data-collection techniques, including satellite monitoring, run-off modelling and flood forecasting; as well as the implementation of a flood-warning system. In spite of these improvements to the flood-management system, weaknesses remained evident and flooding events disastrously re-occurred, most notably in 1988 and in 1992.

Scholars have noted several institutional limitations to adequately addressing the fundamental issue of flooding. First, a failure to adapt the system to natural processes like aggradation and erosion was causing a mismatch between river flow measures and actual hazards. Most water entering the system is withdrawn for irrigation purposes, leaving little water in the system to flush the channels and carry the highest silt loads in the world to be flushed out to the sea.

This long term reduction in channel capacity to carry floods was one of the key reasons for exacerbating the effects of the exceptionally high floods in 2010.

Secondly, monitoring stations were, in some instances, unable to take measurements and report them in a timely fashion due to their own physical location relative to flooding. Even when measurements were taken and alerts were issued, public warning, evacuation and safety measures, in some cases, were ineffective and haphazard. On the flood-management side, canal and reservoir operators were not empowered to make important split-second decisions about flow adjustments that would ease flood hazards, and in some cases reservoir managers, for lack of system coordination, released waters exacerbating deadly down-stream flows.

Besides the systemic weaknesses at the macro scale, the negative consequences of flood hazard at the local scale are often disproportionately experienced by the poor and most powerless segments of the population. Because of hierarchical canal policies practiced by the British colonial administration and then the post-independence Pakistani government, the small farmers were often disadvantaged by virtue of being at the tail end of canal commands.

The canal administration system also has a strong colonial ethos in its legislation and bureaucratic practices, which discriminate against smaller farmers in terms of redressing complaints, water delivery and important levee-breaching decisions. All the infrastructure on the Indus basin rivers has a safe design capacity, which has been exceeded quite often in the past. To protect this infrastructure, upstream levees are often breached to relieve pressure. The operation of the breaching section is a decision taken by the local canal officer who is often influenced by local large-scale farmers. In such situations it becomes a question of which farmer has the most influence to either prevent a levee breach or to affect the breaching of an alternative levee. There are accusations in the Pakistani press that in fact, some of the levees were breached to protect the lands of specific influential interests. The veracity of the media claims is under judicial investigation but, suffice it to say, political influence in levee breaching decisions is a routine occurrence in Pakistan.

This historical perspective of Pakistan flood policy shows that, by ignoring the river's natural systems and marginalising the poor, engineers and water managers have exacerbated the country's physical and social vulnerability to floods. The relationship between anthropogenic environmental degradation and catastrophic flooding in Asia, Latin America, Europe and other regions is well documented. Conversely, we know there is an established link between healthy watersheds with flow capacity – wetlands, marshes, estuaries and mangroves – and flood mitigation.

Since disasters have been shown to be costly to long-term development goals, questions need to be answered about the need to invest in risk reduction. And, with the rising challenges of climate change, we must ask ourselves: can our engineered systems keep pace with climatic trends?

What will change?

So what can we expect to change in the aftermath of this mega-disaster in Pakistan? It is tempting to say that nothing will change given the more than a century and a half of institutional inertia from the Pakistani water establishment. But changes in the aftermath of a disaster of this magnitude are not always planned and deliberate and not limited to formal governmental institutions.

One fifth of Pakistan's population has been affected by this crisis and to pretend that, somehow, after a while, they can go back to normal would be foolish. The new normal is likely to be very different from the old normal, and whether that normal will be for the better or worse is something that the Pakistani and international decision makers can influence and need to be attentive to.

As documented before, in Pakistan the normal conditions for the rural poor are characterised by their virtual invisibility to decision makers, limited access to water, subjugation to larger landowners and fragile livelihoods. But those same normal conditions also have stories of adaptation to adversity and of social mobility. The point is to strengthen the latter in order to mitigate and undermine the former. Dispelling certain misconceptions and highlighting avenues for intervention might help to achieve that end.

In the post-flood scenario, the greatest urgency is dedicated to the usual basic needs such as food, shelter, clean drinking water and so on. But two key issues have not received sufficient attention – the first is of drainage, and the other is targeted assistance to small farmers and the rural poor.

First, the issue of drainage is going to be key – after all according to Pakistan's National Disaster Management Authority (NDMA) as of December 2010, more than four months after the river floods subsided, up to 4,210 square kilometres of land is still inundated in the southern Sindh province. Most of the flooding is from breaching, which typically occurs on the right bank of the rivers, to allow water to drain right back into the river once the flood peak has subsided. In Pakistan, the density of canal, road and levee development has prevented water in the inundation zone from draining back to the main-stem river, instead turning it into a cesspool of disease and delaying the return of affected populations.

Pumping water from such inundation zones should have been a high priority from the start, but there is no evidence to suggest it has been done. Delayed action could have consequences not just for livelihoods but also for the proliferation of diseases and mortality levels. The drainage of flood water should not just be an episodic reactive measure, but a higher priority in infrastructural design or redesign.

Second, the Pakistan government, like most other governments inevitably deals with aggregate numbers

when it comes to relief and rehabilitation aid. The need here is to specifically target small farmers who, with the loss of livestock and summer crop, are particularly vulnerable. There haven't been any systematic vulnerability assessments in Pakistan, except some piecemeal ones undertaken by a few NGOs. Systematic vulnerability assessments must be carried out using some of the insights from recent research.

> *"The priority for dam and barrage management has always been irrigation, power generation and then flood control as an afterthought."*

But in the interim, local level governance structures that used to exist may be resurrected, even if briefly in order to get the local level knowledge to national and international level agencies so that they can target the most vulnerable. There is a sufficiently robust moral economy in rural Pakistan to provide some level of support to the rural poor, but that moral economy has been strained to its limits and is in need of support.

On the institutional side, the government of Pakistan, as usual, received considerable criticism for its slow response to the disaster. While the government merits criticism on many, many counts, in the context of flood response much of the domestic and international attention has been unfair. First, the extent of the disaster is such that no government in

the world could have fulfilled the type of retrospective expectation that the press and the public seems to have attached to its response.

Second, local level is the first and the most appropriate level for responding to environmental disasters, not the national government. The present "democratic" government unfortunately and ironically has eviscerated local level representative government. Third, disaster response in Pakistan is constitutionally a provincial subject, and not a federal subject. The federal government has no constitutional basis to intervene in disaster response unless requested by the provincial government. And when it is requested, the only institution it has to offer is the armed forces – which, by all accounts, are effectively delivering services. So the criticism that the military is doing everything and federal government is not is incomprehensible.

Fourth, even at the provincial government level, populations and geographical areas are so enormous that the functionality of a federalist structure to ensure more efficient devolved government would not hold. Consider that just the Punjab province in eastern Pakistan has a population of more than 90 million. If it were a country by itself, it would be one of the 15 most populous countries in the world. In the absence of local government structures, which the present provinces themselves have eliminated, their efforts for flood relief were also inevitably inadequate.

Flood policy in Pakistan has been somewhat of a peripheral area for Pakistani water managers, and even then it has been limited to concerns with physical risk and exposure reduction. On the physical risk management side the priority for dam and barrage management has always been irrigation, power generation and then flood control as an afterthought. There is an urgent need for Pakistani water managers to be trained to do multi-criteria management of the system, where long term flood management is a priority on par with other priorities. The managers, if trained and given the necessary autonomy, could operate infrastructure in such a way as to flush channels and reduce the need for costly levee breaching during flood events.

Pakistani water managers must also be sensitised to the need for adapting to the rhythms of the Indus basin rivers, instead of maintaining the attitude of heroic engineering to control them. Allowing some inundation zones and restoration of wetlands could go a long way towards moderating high flood peaks, in addition to providing important ecosystem services such as groundwater recharge, carbon sequestration and bio-diversity benefits – which the poor tend to benefit from the most. People living in such inundation zones could be relocated to newer canal colonies after fair and just compensation.

Flood warning systems could also be improved. Pakistan has some of the highest cell phone penetrations in the world – 86% of men and 40% of women in Pakistan use a cell phone. This network could be effectively used as a conduit for emergency information and warning.

And the Pakistani public needs to be educated about flood response strategies and what is expected of them. Greater communication and trust between the flood managers and the people is the ultimate guarantee of safety. It is appropriate that the federal government of Pakistan should limit itself to undertaking technical assistance to the provinces – and then physical assistance if need be – through the National Disaster Management Authority (NDMA). But NDMA has very little budget during normal times and has dubious constitutional authority to intervene in disaster situations. Those constitutional and budgetary issues should be resolved.

But for long term flood hazard mitigation, there is no alternative to being attentive to issues of vulnerability reduction. At the national level, this flood could provide the impetus for the government to undertake some painful but necessary tax reforms to bring larger segments of the privileged Pakistani's income into the tax net. With a tax to GDP ratio of

only 10.2%, the long term ability of the government to invest resources in reducing vulnerability and development is likely to be very limited.

Lastly, representative and accountable local level governance structures are a must to tap information about vulnerable populations and then to target them. International donors and Pakistan's government could fruitfully engage the Pakistani provincial governments to restore local level governance structures so as to facilitate local level development as well as vulnerability mitigation.

The 2010 floods were a disaster, but the disaster can be used strategically to build better and to address better the problematic social and physical factors that contributed to the disaster in the first place. Climate change may not have been a top priority for the Pakistanis but with anomalous meteorological events becoming alarmingly frequent, it is important that Pakistani managers start being attentive to a future world where their past experience of average conditions will not hold. That will mean reworking their operating procedures and managerial outlook. Vulnerability reduction is the best defence they can have against future uncertainty and that is where they need to focus. Hopefully, this intervention – coming in the aftermath of a disaster – will serve as a reminder to focus on vulnerability, adaptation and even some humility in the face of river systems like the Indus.

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First Image by DVIDSHUB
Second image by Oxfam International

August 23, 2011

World Bank: Nepal dams won't stop Indian floods

Indian planners need to radically rethink flood prevention strategies in the Ganges basin, as a new World Bank study debunks old myths. *Joydeep Gupta* *reports.*

For decades, Indian planners working to harness the waters of the Ganges and its tributaries have believed building dams in Nepal will save Bihar and eastern Uttar Pradesh from the floods that occur almost every year. A recent comprehensive study led by the World Bank says this belief is no more than a myth.

The belief was that there were substantial upstream reservoir storage possibilities in the Ganges basin that straddles India, Nepal and Bangladesh. But the Ganges Strategic Basin Assessment (SBA) coordinated by the World Bank and carried out by experts in the region has found that the largest 23 dams that have been conceived would only hold an additional 13 percent of the annual flow of water.

The preliminary findings of the SBA have been presented to government officials in all three countries and were unveiled in public at the World Water Week in Stockholm.

The experts working with the South Asia Water Initiative (SAWI) coordinated by the World Bank found that in terms of flood control, there would be little basin-wide effect of upstream storage, and that effects were unlikely at the sub-basin level either. The models – developed by the Institute of Water Management in Bangladesh, the Indian Institute of Technology, Delhi and RMSI, a consultancy firm in India, and vetted by SAWI experts – showed that at the sub-basin level, the dams would reduce peak flows, but would not necessarily reduce floods. Most rivers in the basin are largely embanked, and local rainfall and embankment failures cause the most flooding, the study found.

Looking specifically at flooding in the Ganges delta, most of which is in Bangladesh, the experts found that the dams in the Himalayas would have a negligible impact on the main stem of the Ganges.

> *"Every monsoon when there is a flood in Bihar, including this year right now, local politicians blame Nepal and the lack of dams there."*

And in a finding that definitely counters the majority view in India, the study found that upstream water storage was not a robust strategy for flood control in Bihar, the Indian province immediately downstream of Nepal for most of the tributaries of the Ganges. Every monsoon when there is a flood in Bihar, including this year right now, local politicians blame Nepal and the lack of dams there.

But the experts found that most of the flooded area in Bihar is outside the basin of the Kosi river, the main Ganges tributary flowing from Nepal to Bihar in India. They also pointed out that most major tributaries of the Ganges in Bihar are embanked, and most floods are from direct rainfall and embankment breaches. In fact, experts have earlier pointed out that repeated embanking since the 1950s and silting of the rivers has created a situation in Bihar where most of the rivers actually flow at an altitude above the surrounding

land. The result is that when the water overflows during the monsoon rains or when there is a breach in an embankment, the land acts like a bowl and is flooded, because the water has nowhere to drain out.

Supporters of building large dams in the Himalayas have also said that the reservoirs behind these dams can be used to augment low season flows. They have pointed out that there is huge seasonal variation of water flow in the Ganges basin, since South Asia gets around 85%of its annual rainfall during the four monsoon months of June to September.

But the SBA has cautioned against this line of argument. It points out that redistributing a small portion of the flood waters would make a big difference to low flows, but the appropriate use and economic value of this water is unclear. Current agricultural productivity in the Ganges basin is low anyway. In waterlogged areas additional low season water could actually be harmful, while the stress on ecosystems and municipalities that would have to cope with the extra water could be high.

So are there good alternatives or complements to reservoir storage in the Ganges basin? The perceived wisdom has been that there is not, but the SBA says yes. The experts say that natural underground water storage, strategically and sustainably managed, could be used in the basin on a scale comparable to the full suite of dams considered in the models. They say there are additional sustainable groundwater resources available in the Ganges basin, in contrast to other parts of India.

Specifically, they point out, there are significant opportunities for additional groundwater use in the basin, in conjunction with a well-managed surface water system in eastern Uttar Pradesh, Bihar and West Bengal. In the Ghaghra-Gomti basin – a sub-basin of the Ganges in eastern Uttar Pradesh – 2.5 million new tubewells can utilise additional groundwater storage of 20 billion cubic metres. There are around 1.75 million tubewells in this sub-basin now, used mostly for irrigation but also for drinking water.

There is another myth that the SBA has punctured. It has often been said that water stored in Himalayan reservoirs can be used to dilute pollution downstream. But the experts point out that any such release would join the Ganges downstream of its most polluted stretches.

There is yet another myth, which says watershed management and upstream storage can control sediment loads. But the experts point out that most dam engineers would want to pass the sediment through, as their reservoirs would get silted up otherwise. Hydroelectric stations also filter out as much of the sediment as they can, because it affects turbine operations.

But after all this, there is one big advantage of building dams in the Himalayas. They would generate a substantial amount of hydroelectricity, the study confirmed. The preliminary finding is that the 14 largest of the dams planned have an installed capacity of around 25,000 megawatts, valued at US$4-5 billion a year. The Ganges basin, with 650 million people the most populous in the world, suffers a chronic power shortage.

Climate change has arrived as an additional complicating factor in the Ganges basin, as elsewhere. Temperatures will increase, glaciers will melt faster, the sea level will rise, rainfall and snowfall scenarios vary widely. The SBA says there are great uncertainties on the scale of the effects, but opportunities to act now. Pointing out that a focus on managing current variability is a no-regrets strategy, the authors say more knowledge and coordination are needed to handle the effects of global warming.

The preliminary findings have four takeaway messages:

- For regional floods, focus on warnings, not just water storage. Upstream storage infrastructure cannot protect the basin. Real, immediate benefits can, however, come from cooperative regional monitoring and warning systems, coupled with localised flood responses.

- For water storage to enhance low flows, look underground, not just upstream. Groundwater storage in the Ganges basin can provide the same scale of effective storage as upstream dams in Nepal, more immediately and at lower costs.
- Hydropower development and trade in the basin remain very promising. There is significant potential to deliver clean peaking power and improve trade imbalances.
- Climate adaptation can begin now, with enhanced and shared information, forecasting and warning systems; flood and drought management; and a major push to the use clean energy.

Joydeep Gupta is project director (south Asia) of the third pole project.

Image by Satish Somasundaram

Part 4: Sharing rivers across borders

Historic tensions exist between neighbours who inhabit the Himalaya and share the major Asian rivers that drain it. But no regional institutions exist to deal with these tensions or facilitate water management between upper and lower riparians. And since mountains and rivers do not obey political boundaries, sustainable development in the Himalayas and all areas downstream is best promoted through a holistic river basin approach.

In this section, Isabel Hilton talks to Indian water expert BG Verghese about regional tensions and opportunity for cooperation. thethirdpole.net presents a series of articles that explore water-sharing issues in the Yarlung Zangbo-Brahmaputra and the Indus river basin. These articles aim to move beyond the half-truths, fear and suspicion that fuel the debate over south Asia's shared waters and encourage cross-boundary dialogue.

Sharing rivers across borders
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May 26, 2010

A mistrustful neighbourhood

BG Verghese is an Indian water expert, political commentator and professor at New Delhi's Centre for Policy Research. Here, he talks to Isabel Hilton about the trans-boundary rivers of the Third Pole.

Isabel Hilton: How would you assess the state of cooperation in the Himalayan watershed?

BG Verghese: It's very limited. There has been a lot of political mistrust; water arouses great emotion and is sometimes viewed in nationalist terms. There have been misunderstandings about the idea that countries "own" water, rather than it being a shared resource. There are different views about prior appropriation as against equitable apportionment, so problems between earlier developers and late starters are cropping up in various places.

IH: Could you expand on the early developer/late starter questions?

BGV: Take the Nile, for instance. Egypt, as a lower riparian, developed what was virtually a virgin, untapped river for its own purposes. That is prior appropriation. When other countries later wanted to develop hydropower, irrigation or flood control, Egypt said they couldn't pre-empt what Egypt had done. Pakistan has developed the Kabul River. Now Afghanistan is askingabout its rights, since the river flows through Afghanistan, but Pakistan is arguing that its development can't be pre-empted.

We have similar problems on rivers in India, but the internationally accepted principle is equitable apportionment.

IH: What is the basis for assigning the shares?

BGV: There are various principles: The Helsinki Doctrine laid down certain guidelines, including the contribution to the water flows made by various countries and populations. There is no hard water law as such, but it's a shared resource and everyone must get a fair deal. Upstream countries have no right to pollute the waters, even if they don't interfere with the flows. These problems take on different characters in different regions.

In this region, India and Pakistan have the Indus River agreement, which is not an optimal solution. With Bangladesh, India has the agreement on Ganges [water sharing] and is trying to reach understandings on the other 53 trans-boundary rivers on the principle of no harm to the lower riparian.

IH: But there are problems between India and Bangladesh?

BGV: There is political mistrust. I don't want to sound very Indian but Big Brother (India) tends to take the rap because of the psychology of small countries where there is mistrust. The classic example is the Farraka Barrage, which India built after independence to divert water into the dying Bhagirathi stream, on which the port of Calcutta stands. Bangladesh argues that the abstraction of the headwater flows by India is causing serious effects in Bangladesh – drying up of the mangroves, affecting drinking water, agriculture, salination, corrosion of industrial plant and so on.

But the reality is that there have been geo-morphological changes in the river. It is moving eastwards and the delta is drying up on the western side and, as the river changes its mainstream course,

it deposits silt, which builds up into little silt dams. Bangladesh has the right to water but is unable to use it during the lean season because of the siltation of the Gorai Hump – a huge silt dam, about 18 feet high [5.5 metres] and 30 kilometres long. When the river starts dropping after the flood season, it cannot cross the Gorai Hump. The lean season is from January 1 to the end of May, and the historical records show that no water used to flow into the Gorai after November. So this is an old problem, but it remains an issue for a lot of people.

On the Barak River, which joins the Ganges and Brahmaputra, there's a storage project in India proposed at Tipaimukh, in Manipur, where various streams join. There's a narrow gorge and it's a good site for a dam. When the Indo-Bangladeshi treaty was signed in 1972, Bangladesh proposed that the Joint River Commission do something about the Barak flooding. After several joint surveys, India proposed Tipaimukh as a probable site [for a dam], but for various political reasons in India, the project did not move ahead.

Now it's being taken forward. It's a 1,500-megawatt installed-capacity dam with eight to nine million cubic metres of water storage, which will moderate flooding and improve navigation downriver. But now there's agitation in Bangladesh to the effect that it will leave the Meghna River high and dry and cause saline intrusion and summer flooding.

Any dam stores the peak monsoon flood and releases it year-round. It would reduce peak floods by 20% to 25%, benefitting both counties, and augment lean season flows by 30% to 40%, so in the summer there would be more water. But the issue is whipped up by the opposition parties in Bangladesh on the grounds that it is a sell-out to India.

I can understand Bangladeshi fears: about 95% of Bangladesh's waters enter the country from India, though they may originate in Bhutan or China. You could say that, for Bangladesh, India controls the taps and can turn them off. But that is certainly not the intention.

Between Nepal and India, there are also problems of asymmetry: Nepal has no real water problem because it only has three to four million hectares [30,000 to 40,000 square kilometres] of arable land, of which the irrigable area is perhaps two million hectares [20,000 square kilometers] in theTerai, bordering India. India says that Nepal has the right to use as much water as it wants since there is a limit to how much it can use and much of it will regenerate in India, through underground flows, unless the water is polluted. For some time, however, Nepal has had the idea that it "owns" the water. One of their chief engineers wrote a book about how hydroelectric power in Nepal was really a by-product of selling water to India. But, in international law, flowing water is like the sun and the air: it belongs to everybody. You are entitled to use it, but not to pollute it. The only charge you can make is for any added value in flood prevention and drought alleviation through storage.

IH: Does that charge only apply to barrages, or does wetland restoration also count?

BGV: No, that is still a natural process. In the Columbia River for instance, in North America, the value of flood moderation is commuted, like a pension. The United States paid Canada around US$50 million [341 million yuan] as the commuted value of flood moderation, though in today's terms that would be more like US$500 million [3.4 billion yuan] or US$1 billion [6.8 billion yuan].

In the pricing of hydroelectric power, if a dam is wholly in one country, the power is sold on a commercial basis. On the Mahakali, which is a boundary river between India and Nepal, the benefits of the dam are shared 50:50 between India and Nepal. If Nepal can't use its 50% share, it will flow to India. Since it is stored water, India paid a notional commuted value in a higher proportion of the capital costs of the dam.

IH: China has very large infrastructure projects and some people in India feel extremely nervous about China's intentions on the Brahmaputra. Do you share these concerns?

BGV: I think they are exaggerated and uninformed. First, the Brahmaputra doesn't exist north of the Himalayas. It comes into being in Assam [a northeastern state of India], where various rivers meet. The scare is that if the Chinese divert the Brahmaputra north, it will leave the Brahmaputra in south Asia high and dry. But more than 70% of the Zangbo, the main stem, is generated south of the Himalaya, so it would not greatly affect India.

Second, you can divert water, but how much? When we talk about the Tibetan plateau most people think we are talking about a billiard table, but the general topography is at 10,000 feet [around 3,000 metres] and the mountains rise to 16,000, 18,000, 20,000 feet. So you are talking about superimposing an Alpine situation onto the Tibetan plateau. If you imagine that you can pump the Rhone across the Alps into Hungary, you haven't understood geography or considered the hydrology, the cost effectiveness or the environmental impacts, which are horrendous at high altitudes. Secondly, the theory seems to be that, since the Chinese built the Grand Canal in the fifth century BC and have now built the Three Gorges dam and the Golmud-Lhasa railway, they can do anything. But if you want to transport this water uphill and down dale, you have to store a large quantum of water and be able to move it.

People say that the Chinese will use the power of the great bend of the Brahmaputra. The maximum drop would be from Tibet to India. Assuming that it could be done, you have to drop the water 2,500 feet to generate 40,000 megawatts. Then you have to lift it back again, 2,500 feet, to get it onto the Tibetan plateau, after which you have to lift it again, several times over, to get it to the Gobi Desert or Beijing. If you generate 40,000 megawatts of power then use it all to send the water back again, you are digging holes in the ground just to fill them up again.

The Chinese have said they intend to use the elevation further north, towards the head waters, where these gorges are already at 12,000 to 14,000 feet and where there is only a 500-metre hump to cross. But the further north you go, the less water there is because you are missing out on the tributary streams and the glacier melt. They are talking about linking the Yarlung-Zangbo River, the Mekong River and the upper Yangtze andmoving the water north, which is a very different ballgame. They argue that this would help China to meet its needs and would provide a flood cushion for south Asia. In times of drought, as a good neighbour, they would open the gates and let the water flow. But this is not a very practical proposition either because there is less water if you go north – and if you go south, you have the energy costs.

There seems to be a debate in China about the south-north water transfer project: the water-resources ministry opposes it as utopian and cost ineffective. It is an order of magnitude and scale greater than anything that has been attempted.

In any case, let's assume some diversion on the Yarlung-Zangbo. Even if they divert up to 20%, so what? It won't affect India and south Asia. It is pointless to get everyone worked up over a non-starter. Nepal and Bangladesh are pleased about the controversy because they think that their local bully (India) is being hit by a bigger bully (China). There are uninformed people in the Indian parliament asking ignorant questions. I think it's a non-starter, bordering on nonsense, but I have no legal or moral quarrel with it. In fact, we could encourage them to get bogged down for 100 years in an unrealisable project.

Isabel Hilton is editor of chinadialogue.

Image by xzly.org

November 24, 2010

Nervous neighbours

Construction of a large-scale dam in Tibet is prompting familiar fears downstream on the Brahmaputra. Joydeep Gupta reports on India's concerns.

Only five rivers in the world carry more water than the Yarlung Zangbo, or Brahmaputra as it is known when it reaches India. Only one carries more silt. Rising at a height of 5,300 metres in the Kailash range of the Middle Himalayas – an area holy to both Hindus and Buddhists – the river flows east through Tibet for 1,625 kilometres before taking a horseshoe bend, changing its name and flowing as the Brahmaputra into north-eastern India.

There, for 918 kilometres, it is both a lifeline due to the water it carries and a scourge because of the floods it causes almost every year. It then takes a southward turn and flows into Bangladesh for 363 kilometres before it merges with the Ganges, together forming south Asia's largest river, the Meghna, and flowing into the Bay of Bengal. This huge river, with its 25 large tributaries in Tibet and 105 in India, drains much of the eastern Himalayas.

As the world's youngest mountain range, the Himalayas are particularly unstable – and so is the river. It has changed its course significantly at least once in the last 200 years, following a major earthquake. Smaller changes in course are common, wiping out farms and homes on one bank while depositing fertile silt on the other. Now humans are changing the course of this river: Chinese engineers have started to build the Zangmu hydroelectric power station in Lhoka prefecture, 325 kilometres from Lhasa, Tibet's capital. The development has led to serious expressions of concern, particularly in India but also in China.

Chinese plans on the Brahmaputra are nothing new. In June 1996, the Scientific American first reported China's intention to divert the river to its north-west territory, mostly covered by the Gobi desert. China's dam projects have long been a source of controversy. Critics say they cause huge environmental problems and do little to control floods, while millions of people are displaced. Earlier this year, Chinese dams were accused of channelling water away from the upper reaches of the Mekong River and contributing to the waterway's record low levels – a charge Beijing has dismissed.

The Tibet Online version of the People's Daily reported that construction of the Zangmu power station started on November 12. The appearance of the report led to immediate criticism from many experts in India and one in China. Though the Indian government has not made any official statement since building started, over the past three years it has repeatedly raised the issue with the Chinese government, expressing concern that the project could disrupt water supplies downstream in India and harm ecosystems.

Now China's foreign ministry spokesman Hong Lei has found it necessary to brief the media on the subject. "In the development of cross-border water resources, China has always had a responsible attitude and places equal emphasis on development and protection," he said, adding that China took "full consideration of the potential impact on the downstream area".

Chinese engineers are asking why India is so worried. Li Chaoyi, chief engineer at China Huaneng Group, the project's main contractor, told news agency Xinhua: "The river will not be stopped during construction... After the project becomes operational, the river water will flow downstream through water turbines and sluices. So the water volume downstream will not be cut."

But India is worried, particularly about one part of the Xinhua report, which said the project "can also be used for flood control and irrigation". This would require diversion and storage of water, experts have pointed out. There will be major impact downstream if any of the 79 billion cubic metres of water that flows down the Brahmaputra into India every year is diverted or reduced. "The diversified fauna and flora there have evolved over tens of millions of years and will be damaged," the Global Times quoted Wang Yongchen, the founder of Beijing-based Green Earth Volunteers, as saying.

Speaking on condition of anonymity, a senior official from India's Ministry of Water Resources said: "While power generation could either be a storage project or a run-of-the-river project, the flood control feature requires storage structures. And the irrigation feature would mean water would be diverted. These features are of concern to India."

The Zangmu scheme will be the first "mega hydroelectric power plant on the Tibetan plateau", according to the Chinese media. There will be six 85-megawatt power-generating units, the first of which is expected to start working in 2014 and to reduce the serious power shortages that now afflict Tibet. The project, which is expected to cost nearly 7.9 billion yuan (US$1.2 billion) according to the Global Times, is a key project for Tibet in China's 11th Five-Year Plan. According to available preliminary information, the Chinese plan to have a series of five medium-sized dams along the river in this area of Tibet.

The issue has been raised in the Indian parliament more than once. On April 22, India's foreign minister SM Krishna told the upper house of parliament: "It is a fact that when I met my Chinese counterpart recently, the question of the hydel [hydroelectric] project over Brahmaputra river being built by it in Zangmu did come up. However, the Chinese foreign minister assured me that it is a small project which will not have any impact on the river's downstream flow into north-east India." Pressed further, he said: "With reference to trans-border rivers, we have an expert level mechanism to address the issue. A meeting of experts from both India and China is scheduled to take place April 26 to 29 in Delhi and the issue will be discussed in it."

The discussion evidently did not satisfy the Indian government, which appointed a group of its most senior bureaucrats – led by the cabinet secretary – to keep a watch on the project. Using data gathered by satellites, the officials alerted the Indian media about the construction in Zangmu almost as soon as it started.

One of the main reasons the Indian government is worried is that it has planned similar hydroelectric projects in its stretch of the river – plans that are under fire from environmentalists. If there is a change in the volume of water flowing into India, those plans will go awry. And the country further downstream, Bangladesh, will probably object to the Indian plans. Swelled by its tributaries while it flows through India, the Brahmaputra carries a huge 570 billion cubic metres past Guwahati, the capital of Assam province, shortly before it enters Bangladesh. It is the major source of water in northern Bangladesh, and any change in its volume is likely to affect the country adversely.

A pure run-of-the-river project may not affect the water volume, since it channels the water through the hydroelectric turbines and then releases it further down the river, but it does affect the amount of silt a river carries. Hydroelectric engineers do not want silt as it clogs up their turbines, and often find ways

to get rid of it before the water enters their channel. But the nutrient-rich sediment is vital for agriculture downstream, both in India and Bangladesh. The Brahmaputra has one of the largest catchment areas in the world – about 580,000 square kilometres – and most of the people within it are farmers.

The Brahmaputra leaves the Tibetan plateau in the eastern Himalayas, which is one of the richest areas in the world in terms of biodiversity. According to WWF, at least 353 new species were discovered in the eastern Himalayas between 1998 and 2008, an average of 35 new species finds every year. Located at the crossroads of two continental plates, the eastern Himalayas supports many of the threatened Bengal tigers and is the last bastion for the greater one-horned rhinoceros. But the biodiversity of the region is already under immense pressure due to deforestation, agriculture, unsustainable fuel wood collection, overgrazing by domestic livestock, illegal poaching, mining, pollution, hydropower development and poorly planned infrastructure.

The impact of these threats is exacerbated by the region's great vulnerability to climate change. There are 612 glaciers in the Brahmaputra basin. And these glaciers are receding due to global warming. Only 25% of the region's original habitats remain intact and 163 species that live in the eastern Himalayas are considered globally threatened, according to WWF. Experts say any change in the Brahmaputra's water and silt volume is likely to have a further adverse impact on this biodiversity.

Chinese officials have pointed out that the Zangmu project is similar to the Baglihar dam, built by India on the Chenab River before it flows into Pakistan. The difference is that India is bound by the Indus Water Treaty to ensure that the project does not reduce the volume of water flowing into Pakistan. India and China do not have such a treaty. Indian officials have said in the past that they have sought a similar agreement without success.

However, in 2006 the two countries agreed to establish an expert-level mechanism to discuss trans-border issues related to using the river as an economic resource and have since signed an agreement for sharing flood-related hydrological data for the Brahmaputra during monsoon season. During the period from June 1 to October 15 each year to 2012, China will provide hydrological data twice a day to India to help better manage floods. After 2012, a fresh implementation agreement will be needed.

Indian officials say their attempts to expand this cooperation beyond the peak flood season have so far not succeeded. Nervous governments and communities along the Brahmaputra will be waiting to see if their neighbourhood can find a way to work more closely together – or if the fears surrounding the Zangmu project will prove to be justified.

Joydeep Gupta is project director (south Asia) of the third pole project.

Image by Boqiang Liao

January 18, 2012

How not to discuss water with China

Debating the precise, quantifiable flows of the Brahmaputra will not foster regional cooperation. Water diplomats should discuss the river's environmental value instead, argues Rohan D'Souza.

China has never been daunted by big engineering. The Great Wall, the Grand Canal and recently the Three Gorges Dam all testify to an almost habitual pursuit of projects involving enormous scale.

Small wonder that many people India see it is as inevitable that China will divert the Yarlung Zangbo for its thirst-ridden cities in the north. This idea is made even more spectacular, given that this siphoning will literally involve taking the waters in a hop-jump-skip equivalent over the upper reaches of three other mighty rivers: the Salween, the Mekong and the temperamental Yangtze.

And even when this unforgiving route is overcome, the flows of the Yarlung Zangbo that have not already evaporated will then still have to be pumped, dropped and shuffled across a whole set of connecting channels, tunnels and sprawling pipelines before finally gushing from turned taps in Beijing.

For many, understandably, this kind of engineering is between implausible and impossible. But can one confidently conclude that a desperately thirsty China is beyond such great, grand and gigantic imaginations about water?

Officially, the Chinese government intends to move 38 to 48 billion cubic metres of water annually from its southern rivers for populations in the north, through the unambiguously titled scheme, the South-North Water Transfer Project. But should these ambitious water diversions unequivocally hold for trans-boundary rivers as well?

One of China's major trans-boundary rivers is the Yarlung Zangbo, which after entering the Indian state of Arunachal Pradesh, opens up majestically within the Assam valley to become India's "moving ocean", the masculine Brahmaputra. Later on, these flows briefly meander as the Jamuna in Bangladesh before entirely folding into the Ganges River, near Goalundo Ghat.

> *Lazy arguments that continue to evoke nineteenth century quantitative hydrology and twentieth century large-dam monumentalism are most likely to fail.*

One river stringing three nations is inescapably a natural geo-political muddle. Anyone, for example, pinching flows can send political ripples and cross-border anxieties. Added to this, the hydrological processes of this complicated fluvial regime – comprising innumerable tributaries, bifurcations and branches – remain little understood.

As yet, the vast mosaic of ecological niches and fluvial habitats of the Yarlung-Brahmaputra-Jamuna system has not been credibly studied in terms of its environmental webs and linkages. Ironically, the lack of knowledge on the river's flora, fauna and intricate ecological relationships has failed to humble those shaping a vibrant discourse over water security for the region. If anything, ignorance seems bliss in

this case; efforts have focused on ascertaining and intensely debating quantifiable flows.

In other words, the environmental qualities of the Yarlung-Brahmaputra-Jamuna have been conveniently ignored. Instead, it has become a river of volumes, compiled as numbers, as averages and as simple statistics.

And herein lies the Chinese water conundrum for Indian diplomacy and its non-traditional security strategists. If negotiations are reduced to ascertaining who is entitled to how much of the volume of water, the game might, in fact, be lost in a single move.

Thus far, the Indian side seems to be fashioning a two-point emphasis: constructing a dialogue for "sharing benefits" from probable hydro-electric projects on the Yarlung-Brahmaputra stretch; and developing a mutually agreeable format for exchanging hydraulic data.

The strategy, however, rests too much on hopes and expectations about reciprocal goodwill. Moreover, China's imperatives or ability to realise kilowatts and cusecs (a measure of flow rate) do not, in any sense, provide compelling urgency for regional cooperation. Flow data, similarly, even when transparent and accessible, can only be read against the grain of several other imponderables.

And most critically, can such water arrangements, even if concluded as a treaty, be contained as a specific deal between India and China? That is, can India's understandings with China be prevented from an interpretative spill over into existing water treaties, or significantly trouble other delicately poised discussions over trans-boundary rivers in the region? After all, India held the upper riparian position on previous major treaty negotiations: theIndus Water Treaty with Pakistan in the 1960s; and the Ganges Water Treaty with Bangladesh in the 1990s.

Upper riparians have an unstated advantage in the creation of hydraulic facts and can carry their topographical strength into concluding any arrangement. But clearly, in the case of the Yarlung Zangbo, India is in the weaker position, and bargains with China over a likely water treaty will put Indian negotiators in a technical context that for the latter, at least, entirely lacks historical precedence.

Put differently, the Indian side will need to develop a new language game which, above all else, provides a novel architecture for discussions that are based on an entirely different set of hydraulic concepts and categories.

Interestingly, cutting such a fresh path will be a lot easier than pursuing an intense, dogged and grinding exchange over contested river flow data. Since the 1990s, a dramatic scholarly turn has occurred in several social science disciplines with the theme of water as a central narrative. A range of publications in anthropology, sociology and history, have decisively altered our understanding of river management and hydraulic control.

An issue of the journal Nature in 2010 highlighted the urgency for an "integrative water approach" to strike a balance between human resource use and ecosystem protection. In effect, hydraulic and riverine habitat diversity have to be sustained if human consumption requirements are to be met in the long term.

It is imperative that Indian water negotiators harness this fresh research. Lazy arguments that continue to evoke nineteenth century quantitative hydrology and twentieth century large-dam monumentalism are most likely to fail.

Indian negotiators can make a more meaningful case by discussing the strong interconnections between hydraulic diversity on the one hand and livelihoods and intricate social dependencies on the other – rather than emphasising statistical simplifications about river flows.

Rohan D'Souza is assistant professor at the Centre for Studies in Science Policy, Jawaharlal Nehru University.

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Image by Rita Willaert

November 01, 2011

Saving south Asia's water

Geologist, explorer and independent scientist Yang Yong tells Beth Walker what he has learned about sharing water resources from over 20 years spent rafting China's rivers.

Yang Yong has spent over 20 years rafting on China's rivers, exploring the network that drains the Tibetan Plateau. Yang was one of first rafters to navigate the perilous upper reaches of the Yangtze and the Yarlung Zangbo to investigate the geological and hydrological conditions of the river basin. He has observed the impacts of climate change and development, and seen the snow and ice of the world's third pole disappear before his eyes. Speaking to Beth Walker on the sidelines of a third pole media workshop to discuss the impacts of climate change on the Yarlung Zangbo in Kathmandu this month, he discussed his work and the future of Asia's rivers.

Beth Walker: Can you explain the importance of the Yarlung Zangbo River [known as the Brahmaputra in India]?

Yang Yong: The Yarlung Zangbo is an important source of water for China, India and Bangladesh. The river provides important economic benefits and supports livelihoods, especially in Bangladesh where the river runs through densely populated areas. Where the river begins in Tibet, it represents the cradle of Tibetan culture. The river is sacred for local people who have built temples and carry out religious rituals along its banks. The source of the river is found on the slopes of Mount Kailas (the western section of the Himalayas), where Buddhist, Hindu and Bon gods are believed to reside.

BW: Why did you become interested in rivers? And why particularly the Yarlung Zangbo?

YY: I grew up in a small village up on the cliffs by the valley of Jinsha River (upper reaches of the Yangtze River), in Jinyang county in Sichuan, southwest China. When I was young, my mother told me not to play by the river, otherwise Shui Long Wang the river dragon that lived below would pull me into the river. Back then the river below in the deep valley remained a mystery to me. It marked the edge of my childhood world and drew me in. When I grew older I decided that I had to explore the river by rafting. At university in Chongqing [western China] I studied geology at the China Mining Industry University and this formed the foundation of my later research.

> *"In 1986, I rafted the Yangtze from source to mouth to collect hydro-geological and geological data. Fifty-five people took part in the expedition and 10 people died when our boats capsized."*

I began to explore all the rivers of the Tibetan Plateau in the 1980s. There had been very little research done and no data available for many parts of the rivers. In 1986, I rafted the Yangtze from source to mouth, through canyons that had never been passed through to collect hydrological and geological data, and to record information about the river valley and the landscape along it. Fifty-five people took part in the expedition and 10 people died when our boats capsized. Since then I have walked along and intensely examined the most important sections of the river.

I discovered there was less and less water on the upper tributaries of the Yangtze and intensifying soil erosion and geological disasters after the river and its tributaries have been developed since the 1980s. So I went in search of other water sources on the Tibetan Plateau. In 1998 I led a similar research adventure along the Yarlung Zangbo – the first descent of the river from the source to the Great Bend before the river flows into India. I wanted to understand how this river could pass through such a deep gorge, over 5,000 metres deep, the deepest gorge in the world. We travelled 1,800 metres by raft and 400 kilometres by foot over a period of over four months. Since 1998 and 2010, I have been back five times to research the river.

BW: What impacts of climate change have you observed over the 20 years you have carried out your research?

YY: Our 1998 trip along the Yarlung Zangbo took place just after major floods ravaged the Yarlung Zangbo River, the middle and lower streams of the Yangtze, the Song Hua and Nen River in northeast China. I believe these floods were a sign of climate change. I have seen an accelerated melting of glaciers on the Tibetan plateau, on average between 200 and 500 metres for the majority glaciers over 20 years.

Desertification of grassland has spread, in places across patches over 100 kilometres long and 10 kilometres wide in the upper stream of Yarlung Zangbo. In some places the different sand dunes patches have connected. This has been caused by climate change and convincingly as well by human activity. In Zhongba county in the Shigatse region of western Tibet, people have had to resettle two or three times because of the accelerating desertification process. If desertification continues, it will decrease the flow of water downstream and eventually this region could become a second Taklamakan desert. There have also been an increasing number of mudslides caused by glacier avalanches, and this increases the chance of geological disasters.

BW: How should the three countries through which the Yarlung Zangbo flows tackle these environmental issues?

YY: The three countries – China, India, and Bangladesh – should cooperate to utilise its water resources and design a comprehensive river basin plan. This must include measures to predict and control hazards, such as floods, landslides and other geological disasters, the impact of hydroelectric projects, changing river flow, and procedures to address and respect each country's water needs and rights. NGOs and media and scientists all play an important role in encouraging this collaboration.

BW: There has been a Chinese proposal to build the biggest dam in world at the great bend of the Yarlung Zangbo. What will the environmental impacts be?

YY: Since 2006, the government has planned to build nine dams in succession, with a capacity of over 40,000 megawatts at the 400-kilometre long "great bend" of the Yarlung Zangbo before the river flows into India. The basic technical idea is to divert the water directly before the bend, and the water will merge back with the mainstream afterwards. The dam will consist of nine tiers. At this point the water flow drops down a height of over 2,000 metres and therefore you don't need to build a big reservoir, or inundate a lot of land, to generate huge amounts of electricity.

Theoretically, the dam will not impact the water flow downstream. But the construction may cause environmental problems and geological risks that need more attention. The dam site lies within an immensely deep gorge that has rich biodiversity and complicated geological conditions. This makes construction and getting machinery to the site very challenging. The biggest concern is the geological risks. The project is at the convergence point of three gigantic mountain ranges and several very big rivers. Given the risk of earthquakes and mudslides, more research is needed before plans go ahead.

Construction of the Zangmu dam on the upper Yarlung Zangbo has already begun and is one of five relatively smaller dams planned in a much smaller gorge. But it only controls water flow of its upper stream, and this area is not so geologically sensitive.

BW: India and Bangladesh are very concerned that China's hydro dams and water projects will reduce downstream water flow. Are these concerns founded?

YY: There are two issues here. Firstly, India and Bangladesh's concerns over reduced water flow due to Chinese projects are not based on scientific evidence. The water flow of the Yarlung Zangbo at the point where the dam is under planning counts for only 50% of the total outflow of the river at the other side of the bend before the river enters India, and roughly eight times greater once it reaches the Bay of Bengal. Even if China went ahead with diversion plans on the river [the Chinese Water Ministry announced it will not in October], water flow downstream would not be affected. Myths about this have been fuelled by media hype.

Secondly, Chinese dams on the upper stream section could in fact provide benefits to Bangladesh by controlling the water flow and floods in summer if these dams store enough water. In any case, the planned dam at the Great Bend at Motuo will not happen for at least 10 years. It is still not clear how the power will be used. If it just goes to Tibet, which is not linked onto the electricity grid at present, the project will not be economically viable. More likely, electricity will be used to meet demand in south Asia. The three countries need to communicate with each other better and to collaborate particularly on issues of flood control.

BW: What are the biggest threats facing [dam projects] on the Yarlung Zangbo River basin?

YY: The biggest concern is the geological threats and impacts on biodiversity, in both China and India [where the authorities plan to build 70 large dams in an earthquake-prone region]. If an earthquake occurs, dams will burst and cause destructive floods downstream, such as the massive flood on the Yigong River [a tributary of the Yarlung Zangbo], when a barrier lake breached, causing deaths and destruction in southern Tibet and India in 2000. There needs to more research carried out to increase the understanding of earthquake tendency as well as geological risks, stronger regulation of dam construction and trans-national coordination. All countries involved should work closely and strive to lay a good scientific foundation before any significant developments rush in.

Beth Walker is a researcher for the third pole project.

Image by lacitadelle

September 08, 2011

Wanted: bridges over troubled waters

Getting India and Pakistan to communicate openly about river resources may seem an idealistic dream – but it's still the best bet for resolving conflict, writes Joydeep Gupta.

Editor's note: *Water has always been a flash point between India and Pakistan. The two neighbours compete over use of the waters of the Indus River, the backbone of agriculture and industry in both states. As the Indian subcontinent was parted in 1947 to create the new state of Pakistan, the rivers were partitioned in 1960 through the Indus Waters Treaty (IWT). Five decades on, the radically altered landscape of Asia's water resources has put the agreement at risk.*

Both India and Pakistan face a deepening water crisis, driven by population growth, industrial demand and gross mismanagement of water resources. Climate change has added fuel to the flames. Melting Himalayan glaciers are projected to reduce the flow of water in the Indus Basin, particularly for Pakistan, which is now calling for an urgent revision of the treaty. As national policymakers increasingly couch water resources in terms of national security, hard battle lines have been drawn.

In an attempt to bridge the polarised debate, third pole presents two more nuanced perspectives. Indian journalist Joydeep Gupta and Pakistani academic Maaz Gardezi each offer a tentative way forward towards a more constructive cross-boundary dialogue over water resources, one that looks beyond national security and takes a more holistic ecological perspective.

As Pakistan went to the Court of Arbitration in The Hague once again in mid-August 2011, seeking an order for India to put on hold construction of the Kishanganga dam until the final decision of the court, the overwhelming response among Indian policymakers was: "Oh, not again."

The project on the Jhelum River, one of the main tributaries of the Indus, has been opposed by Pakistan since it got off the drawing board. But India has steadfastly maintained that the run-of-the-river project follows the 1960 Indus Waters Treaty between the two countries to the letter. Just about everybody in India feels that the treaty is the best basis for apportioning the waters of the giant Indus river basin, that India as the upper riparian country has stuck to the treaty through war and peace, and that Indians are unfairly blamed for Pakistan's water woes to cover up the inefficiency or worse of the water policymakers in Pakistan.

> *"The trust deficit is so high – especially in India – that anybody advocating a dialogue would be lucky not to be dubbed a spy."*

Given the near-unanimity of this view in India, and the near-constant rhetoric in Pakistan that "India is stealing our waters", there is very little space for any level-headed, rational and scientific conversation on the subject. The trust deficit is so high – especially in India since many of the country's terrorist attacks over the last three decades have been traced back to Pakistan – that anybody advocating a dialogue would be lucky not to be dubbed a spy. Anyway, Indian officials firmly hold, there is nothing to talk about: there is a treaty, India is sticking to it, that's the end of the matter. And if it is not, the officials in New Delhi add, both governments have a permanent

Indus Water Commission that is meant to sort out all issues, so why is there any need for anybody else to get involved?

Expectedly, this line of argument does not go down at all well in a water-stressed country like Pakistan, especially when the average Pakistani sees in the media that India is building structures upstream that can potentially choke off a part of the river flow. Knowing the extent to which it is under international scrutiny, India has not and is unlikely to build any structure that will reduce by even one cubic metre the volume of water it is supposed to supply to Pakistan under the treaty. But thanks to the trust deficit, few Pakistanis feel reassured.

Recent projects like the Kishanganga dam have no doubt added to the worry in Pakistan, though Indians are going blue in the face assuring the Pakistanis that the hydroelectricity project will not hold back any water at all, and that the project is being carried out as per the 1960 treaty. Indian planners point out that they cannot really go further and scrap the projects altogether – the parts of Indian-administered Kashmir through which the Indus and its western tributaries flow are chronically starved of electricity, and there are few economically viable options to meet the need other than hydropower.

It looks to be a situation where only open dialogue between India and Pakistan at every level – government, media, civil society – can clear the air. The chances of such a dialogue do not seem high at the moment, but it is nonetheless vital to keep striving for this. It is vital not only to build trust, but also because now there are two factors in the water-sharing puzzle that were not taken into account by the Indus Waters Treaty: deforestation and climate change.

The Indus and its main tributaries rise in the Tibet Autonomous Region (TAR) of China, and flow through India on their way to Pakistan and then the Arabian Sea. When the Indus Waters Treaty was signed in 1960, the volume of water was apportioned between India and Pakistan on the basis of the assumption that the flow of the water in the rivers would remain constant. This assumption is now in question due to these two factors.

While there are few official reports about the extent of deforestation in western TAR through which these rivers flow, there is plenty of anecdotal evidence that the already-sparse tree cover of the Tibetan Plateau is being rapidly denuded. Indian hydrologists have reported an increase in the silt load in the rivers as a result. They are expecting an effect on the water flow, but are uncertain of what the effect would be. The same goes for the effects of climate change. While some of the large glaciers of the Karakoram Range that feed these rivers are expanding, most of the glaciers in the western Himalayas – including the Karakoram Range – are receding due to global warming. The net effect on water flow is unpredictable, but likely to be negative, the hydrologists say.

So there is a treaty that apportions a certain amount of water between India and Pakistan. What happens to the treaty if that amount is no longer certain? How will the two countries amend the treaty – for which it does have a provision – for a fair water-sharing arrangement in the future? It requires a cool-headed, civilised dialogue to even start to answer this question. Then it requires a lot of scientific research in both countries to reduce uncertainties in the water flow projections. And it definitely requires close cooperation from the authorities in China, where the rivers originate.

Anybody advocating these steps would be considered dangerously naïve by most people in India and Pakistan today. But not to take these steps may prove even more naïve in the long run.

Joydeep Gupta is project director (south Asia) of the third pole project.

Image by International Rivers

September 08, 2011

Tackling old fears in Pakistan

The 50-year-old treaty governing water-sharing in the Indus basin has failed to fix the culture of recrimination. It's time for broader collaboration, says Maaz Gardezi, from Pakistan.

A typical Pakistani newspaper article on the Indus Waters Treaty begins by explaining the essential elements of the 1960 agreement with India – allocation of western rivers to Pakistan and the eastern rivers to India, restrictions on building water storage infrastructure, and the underlying dispute resolution mechanism – before citing a few examples of finger-pointing across the border, and concluding in the classically paranoid tones of a lower riparian.

Cases such as the Baglihar Dam, the Kishenganga Dam and the Wullar Barrage, where Pakistan claims violations of the Indus treaty terms, are brought up time and time again, and their outcomes are monotonous: the two nations are unable to reach an agreement, and the case is taken to a neutral expert for mediation, or to theInternational Court of Arbitration. Although these issues may be important for Pakistan's sustainability, it seems the resulting discourse has left little, if any, space for cooperation.

The Indus Basin was developed by the British to function as a single system; but the enormous water works built to control and to use the river's water for certain limited ends, has since been split in two. The boundary that now separates Pakistan and India – the Radcliffe Line – was crudely drawn up in 1947 to divide an area shared by competing nation states. It was not chosen with the impacts it would have on the river basin in mind.

For 13 years after the division, the two countries maintained the system. This was a period of inefficient water management, continued hostilities and a wider anticipation of a final settlement. The Radcliffe Line, that not only divided the land but also the water of Punjab, received condemnation from both countries. Finally, in 1960, the two nations signed a water treaty under the auspices of the World Bank.

> *"The treaty promotes a passive aggressive stance between the two nations, which is precisely what the establishment requires to maintain its status quo."*

Some might argue that the Indus Waters Treaty has performed very well for the past 50 years. After all, it has survived three wars. But there is an underlying reason why this treaty has been so popular on both sides: it promotes a passive aggressive stance between the two nations, which is precisely what the establishment requires to maintain its status quo. It creates fear among the Pakistani population, based on the idea that India is "stealing our water". The rhetoric becomes uncontrollable when it gets into the hands of non-state actors, right-wing religious hard-liners whose purpose is to depict an India driven by cruel intentions.

When it comes to managing trans-boundary waters, change is the only constant. Change management requires a shift in the paradigm: the way we understand the river basin, its people and their livelihoods. Water is a finite, freely flowing resource that should not be divided by geopolitical boundaries.

Environmental and ecological concerns are extremely important. A regional approach is required to maintain the prosperity and dominance of the mighty Indus.

Article seven of the Indus Waters Treaty mentions "future cooperation", which points to future efforts to jointly optimise the potential of the Indus River system. But very little attention has been paid to cooperative projects: the joint observation of discharge which enables correct measurement of water entering into Pakistan along with the environmental flows and earthquake risks; and the potential of joint engineering works to augment storage, produce power and better moderate floods.

Certainly, a trust deficit exists between the two countries. Experts suggest that advance information to the lower riparian – Pakistan – about planned interventions such as dams and barrages, and when reservoirs will be filled, can bridge these issues. However, this seems hopelessly unlikely given cases such as Wullar Barrage, a stalemate case, which has been in its negotiation stage for 26 years.

We cannot depend on a few state-actors to determine the fate of relations between the two countries, and instead should work towards a more informal diplomacy that involves non-officials in transboundary water management. By bringing together state and non-state actors, such diplomacy also provides a way for poor and marginalised communities to voice their concerns, which should be reflected in national and sub-national decisions on water management projects in the region.

One area where collaborative work should be urgently undertaken is on ground-water aquifers, especially near the border areas of Pakistan and India. The Indus Waters Treaty only considers sharing of surface water discharge from the rivers and overlooks groundwater abstraction. A study conducted by the International Union for Conservation of Nature (IUCN), using analysis from NASA's Gravity Recovery and Climate Experiment, found that the aquifers of Pakistan will be affected by the disproportionate abstraction of groundwater in India. It concludes that "the issue of transboundary groundwater with India has to be addressed and an addendum has to be negotiated between basin states for inclusion in the Indus Waters Treaty."

The 1994 Jordan-Israel Treaty can help us learn manageable ways of dealing with both ground and surface transboundary water. Moreover, there are global laws governing transboundary aquifers, such as Article 42 of International Water Law. Any effective water-sharing agreement must be extended to include groundwater.

First it was the territorial dispute over Kashmir, now it is water: tension in this part of the world is nothing new. The difference between these conflicts is that the latter is an existential issue. Pakistan has survived without Kashmir for 60 years; it will not survive without water for even 60 days. Bringing water to the forefront of Indo-Pakistani relations could have a devastating effect on regional security and prosperity.

It is pertinent to Pakistan's growth that we form our water policy based on a holistic approach. We need to work closely with our neighbours in order to share this resource, rather than divide it. I find it necessary to cite the views of Indian water policy expert Ramaswamy Iyer, who has called for a new approach to national water policy: "The best way of avoiding conflicts is for the upper riparian (India) to adopt a cautious and minimalist approach to such interventions; undertake them where absolutely necessary with due regard to the interests of the lower riparians (Pakistan); provide advance information to the latter about plans for intervention; consult them at all stages on possible impacts; and take care to avoid significant harm or injury to them."

Other Indian policymakers are also becoming more sensitive to the anxieties of Pakistan. In order to improve water cooperation, concerns of the

downstream country need to be addressed through initiatives that build trust and share knowledge across borders.

Maaz Gardezi is a research associate at Lahore University of Management Sciences' Development Policy Research Centre.

Image by International Rivers

Part 5: Conservation and communities

The third pole is one of the world's most biologically and culturally diverse regions. The land covers ecological zones from arctic tundra to tropical jungles, the deepest canyons and the highest peaks. It is home to thousands of varieties of plants, rare medicinal herbs and many endangered species, such as the wild yak, snow leopard and the migratory Tibetan antelope. The panda is also native of the Tibetan plateau. Over 600 languages are spoken in the Himalayas, a reflection of the region's cultural diversity.

The following section tells the stories of communities and animal species struggling to adapt to increasingly erratic weather patterns and economic development. Marc Foggin shares rare photos of the endangered snow leopard as he documents a community conservation project. Athar Parvaiz reports on innovative solutions to water shortages developed by farmers in the arid reaches of north-west India. Xia Liwei talks to Tibetan herders adjusting to sedentary life on the edge of Golmud city. And Tashi Sange explores people's relationship with nature through a Chinese folk story about the Tibetan black-necked crane.

Conservation and communities
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November 08, 2011

Tibet's snow leopards

Local herders are central to protecting the snow leopard in the source area of the Yangtze River. J Marc Foggin introduces a series of photos documenting the community conservation project.

In a remote area of Yushu Tibetan Autonomous Prefecture, in China's western Qinghai province, local Tibetan herders have been actively protecting the snow leopard and other endangered wildlife in the high grasslands and mountains for more than a decade. Now, with help from non-profit organisation, Plateau Perspectives, and the Sanjiangyuan National Nature Reserve, they are also using "camera traps" to photograph the animals and better document their distribution, range and behaviour. The images presented here include some of the first photographs taken.

There are fewer than 7,500 snow leopards worldwide, according to the latest estimates from a dozen countries. Around 60% of this elusive species' potential habitat is in China, most of it on the Tibetan Plateau. Conservation efforts are crucial and the people of Muqu village are supporting them in several ways, serving as park wardens, environmental advocates and as partners in applied wildlife research.

Such commitment to environmental protection is rooted in the community's involvement in a more people-centred approach to environmental management, known as "community co-management". When locals are treated as genuine partners and allowed to voice their concerns as well as sharing their knowledge, there is a real opportunity to find better models for a sustainable future.

In remote mountain areas of the world, if we are to succeed in protecting the snow leopard, for example, we must equally protect its fragile habitat. To protect the snow leopard is to protect the entire landscape and many other species and habitats will in this way be preserved as well.

For over a decade, around a dozen members of Muqu village have served as wildlife monitors and searched for snow leopards in their rugged mountain terrain. Many different signs can be seen – prints, scrapes, scat and kills – and several times a year, these herders report all their sightings as well as any instance of livestock predation or poaching. Now, with the advent of technologies such as global positioning systems (GPS) and digital cameras activated by motion sensors, an increasingly clear picture of the conservation situation is emerging.

Since 2009, over a dozen camera traps have been set in the mountains of western Yushu, located according to the extensive knowledge of local herders. Nine individual snow leopards have already been captured on film, within an area of about 150-square kilometres. Clearly this geographic area has one of the highest densities of snow leopard in the world. Many other species also live here, including blue sheep, Tibetan antelope, wild ass, wild yak, black-necked crane and saker falcon.

But when snow leopards and wolves flourish, the number of livestock killed by these predators rises – and herders are starting to ask about financial compensation. On the one hand, people want to protect the land and wildlife, but on the other hand, the cost is sometimes deemed too high. Developing alternate sources of income for local herders is

crucial, and the solution currently being explored is ecotourism.

While there are many challenges to developing an economically viable and equitable ecotourism project, the potential benefits have swayed many people in the area to give it their best effort, including tourism bureaus and several responsible business partners, community representatives and non-profit organisations. If projects in the Yushu area are well designed from an early stage, then community-based tourism could flourish, bringing benefits to local people. The environment could also be better preserved and more easily appreciated by the nation as a whole.

The benefits of working in genuine partnerships with local communities in the source area of the Yangtze River are already clear. Together we can find viable solutions to protect the high mountains, the grasslands and the wildlife of the Tibetan Plateau. And both the elusive snow leopard and local herders will enjoy the results.

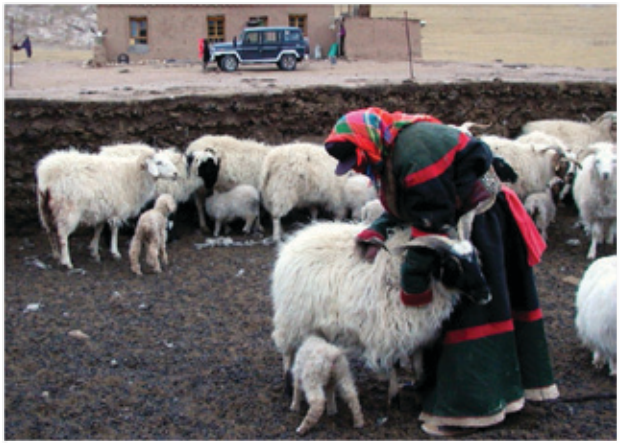
J Marc Foggin has worked in China for around 15 years, focusing his attention on conservation and community development on the Tibetan plateau. He is founding director of international NGO Plateau Perspectives and associate professor in the School of Geography and Life Sciences at Qinghai Normal University. He lives in Qinghai

Images by J Marc Foggin

TIBET'S SNOW LEOPARDS

***A tributary of the Yangtze River meanders through the grassland**, past the small township of Suojia in Yushu Tibetan Autonomous Prefecture, Qinghai Province. Suojia Township encompasses a significant portion of the upper reaches of the Yangtze River, known locally as the Zhiqu River. The vast alpine grassland and wetland ecosystems have long been used in sustainable ways by local communities, and are now part of the Sanjiangyuan National Nature Reserve.*

The main livelihood of Tibetan people in the high altitude grasslands of the Tibetan plateau is animal husbandry, mostly yak and sheep. These animals are well adapted to the harsh environmental conditions. Yak can be used to provide for many basic needs: milk is converted into different food products and yak hair used to weave "black tents", while the animals are also used for transportation and meat.



Sheep also form a significant part of local pastoral livelihoods. Herding is done by both men and women, while most of the home-based work, such as milking, has traditionally been done primarily by women.

One of the first wildlife monitoring teams formed in 2001 to carry out a survey in "snow leopard valley". Members of a local grassroots organisation and a branch of the local monastery participated in this early conservation work together with Plateau Perspectives. They observed many signs of snow leopards, including prints, scrapes, scat and traces of recent kills.

The Muqu village school was established in 1999, supported by the local Upper Yangtze Organization and Plateau Perspectives. In the background, the rugged mountains provide excellent snow leopard habitat. Many blue sheep can be seen in the area, and one leopard has been photographed less than one kilometre from the school.

The first joint planning meeting with nature reserve staff and local herders occurred in Suojia in 2007, inaugurating a new collaboration based on the key principles of "community co-management.

An automatic camera trap, activated by a motion sensor, is placed in a gully behind the home of a community leader, in a mountain range known to have many snow leopards. Set up in December 2009, this and other camera traps in the same range took their first photographs less than three days later. Information from such photographs can help to identify individual snow leopards, and better understand their distribution, range and behaviour.

The snow leopard was selected by local community members and nature reserve staff as the first focal point around which to trial the community approach to wildlife conservation. This photo was taken on 20 April, 2010 in the Tseren mountains.

Focusing conservation efforts on the charismatic snow leopard will bring broader benefits. If the snow leopard is conserved, then many other species in the same habitat are also likely to be protected. Meanwhile, the presence of such an elusive animal will draw visitors, helping to develop the fledgling "community ecotourism" industry as an income stream for local people. This photo was taken on 8 January, 2010 in the Tseren mountains.

Cultural events, such as this local festival, can help to promote community discussion and cohesion. At this festival, meetings were held that led to the formation of a wildlife monitoring team to focus on Tibetan wild ass.

Tibetan wild ass, or kiang, are common in many parts of the Tibetan plateau, yet little is known about their specific movements. Herders say kiang compete with domestic animals over forage, but more research is needed in order to make appropriate management plans.

A neighbouring Tibetan herding community focuses on monitoring and protecting the local wild yak population. Several other community-based conservation and development projects are now being developed in the region, largely under the auspices of the Forest Bureau. These should be supported and further studied to determine what makes these initiatives a success.

Many development and conservation policies now affect the region, including the development of winter homes in grassland areas and resettlement schemes. Collaborative management approaches may prove to be amongst the most effective ways of reconciling environmental and development goals. Support is strong, even in local government bureaus, for finding ways to promote eco-friendly approaches to rural development.

Some local government bureaus also support fencing in grassland areas, which may effect wildlife movements and hence impact the biodiversity conservation goals of protected areas. It is important for such programmes to be examined from an interdisciplinary perspective.

The Kham Tibetan people of Yushu Tibetan Autonomous Prefecture have a rich culture and history and a strong pastoralist tradition. Involving locals in the management of natural resources may be an effective way to bring sustainable development to the region and protect the fragile ecology – and ecological functions – of the Tibetan plateau.

November 15, 2010

Fragile adaptation in Ladakh

Destructive floods have led farmers to question their ability to survive in the arid reaches of the Himalayas. Athar Parvaiz reports from north-west India.

> *The government and NGOs are making no effort to restore the damaged land – the main source of survival for the farmers – to its original state.*

The devastating flood that struck the normally arid desert of Ladakh, north-west India, in August has multiplied the worries of local farmers, already struggling with water shortages and harsh climatic conditions. Flashfloods and mudslides killed 233people and damaged 14.2 square kilometres of agricultural land.

Tucked high up in the western Himalayas, Ladakh is a sparsely populated, rugged desert where people struggle to turn barren and parched soilinto cultivable land. The soil of Ladakh is not fertile and absorbs little water. Average rainfall is only 50 to 70 millimetres a year. In these adverse conditions, farming is an unenviable task, butdiligent farmers, with support from NGOs, have created an irrigation network covering 50 square kilometres of agricultural land in Ladakh. This allows them to live off the land, against the odds.

But nothing prepared farmers for August's weather events. Unprecedented cloudbursts triggered flash floods, which in turn deposited thick layers of debris on the agricultural land and destroyed over 70% of the irrigation network built up by the farmers over years of hard work. "Crops can only be cultivated on this land after the flood debris is cleared and the top soil is exposed," said Lobzang Tsultim, director of local NGO Leh Nutrition Project. "Obviously, the farmers can't clear this debris manually, they need JCB machines, which the government and NGOs need to provide to them."

According to Tsultim, the government and non-profit groups are making no effort to restore the damaged land, on which the farmers' livelihoods depend, to its original state. Apart from tourism, farming is the main occupation of people in Leh district. An average farmer makes up toUS$1000 (6,680 yuan) every year by selling crops like barley, potatoes, wheat and other products to the Indian army.

The recent floods have intensified local people's fears about the shifting climate. They are unable to decipher or explain the erratic weather patterns, but have no doubts that conditions are changing.

"Glaciers are receding rapidly and the winters are getting shorter and warmer. The snowfall which we do get, melts quickly," said Tashi Namgiyal, a farmer. He added that the popular "Chadar Trek", a crossing local Tibetans have made for generations during winter, when the Zanskar River surface – part of the Indus watershed – freezes solid, is now possible only for two months. It was previously possible from December to March."We are now seeing pests in upper villages that used to be found only in villages lying lower," he added, pointing out other signs of changing conditions. "We are also witnessing shifts in sowing and harvesting of barley."

Tsultim agrees with this assessment: "Whether you call it man-made climate change or attribute it to other natural process, we are experiencing a lot of changes around us. Our region is arid and we have small glaciers which we draw water from. But over the last several years, many of these glaciers have receded. Not only this, we have seen some of our limited pasture lands drying up because of water scarcity."

The farmers worry they may have to migrate away from their native land if the glaciers – their source of water – continue to diminish. "Farming is the only art we know. If there is no water left, there would be no agriculture, meaning we might have to leave this land one day in search of water," said another farmer, Sonam Tundup.

But Tsultim believes there are other choices. The Leh Nutrition Project has worked with Chewang Norphel, a civil engineer known as the "Iceman", who has pioneered innovative adaptive solutions to water shortages, including artificial glaciers – created by diverting a water course, lowering its velocity and volume and getting it to accumulate in the shadow of a hill. [See chinadialogue article "The iceman of Ladakh" for more on Norphel's work.] These artificial "glaciers" provide water to irrigate farmland in the early cultivation season, when there is not enough water available fromnatural glaciers.

Norphel's determination to help famers adapt to climatic changes has not stopped here. He is now building a reservoir near a huge wasteland, whichwill transform the area into cultivable land for the farmers of Chamdaydo village. The 74-year-old has already created almost 40 reservoirs in as many villages, enabling farmers to turn wastelands into fertile farming territory. Tsultim asserts that adapting to the changing climate is the best option. "You have to either adapt or become extinct." This is the message he wants to give farmers.

Athar Parvaiz is an environmental journalist based in Kashmir.

Image by Athar Parvaiz

November 03, 2009

"There's no doubt it's getting warmer"

Receding glaciers increase the risks to already perilous lives and livelihoods high in the Himalayas. Joydeep Gupta reports from the mountains of north-west India.

The annual monsoon that is the lifeline of south Asia stops at the 5,000-metre slopes of the Pir Panjal range in the Himalayas. The Tibetan plateau effectively starts on the northern slopes of the Lahaul and Spiti valleys in the Indian state of Himachal Pradesh. Little glaciers roll down both the northern and southern slopes, later turning into streams that feed the mighty Indus River system that straddles India and Pakistan.

The trouble is that the glaciers are getting smaller – and so are the streams. "Do you see that glacier coming down the saddle between those two peaks?" asked local farmer Vikas Sharma in late September. "We call it sona pani [gold water], because that is the water that irrigates the farms in my village, Kumpi, which you can see near the bottom of the valley."

"Until 10 years ago, that glacier used to come right down to the bottom of the slope. For at least nine months of the year, it used to start melting only when it reached the outskirts of our village," said Sharma. "But then it started to melt higher and higher up the slope, and there was less water too. Now it is September – just after the monsoon, when it should have the maximum ice – but it's only halfway down the slope. I don't know how we are going to irrigate our crops next summer."

His village is not the only one where people risk losing their crops due to shortage of water. Sona pani is part of the complex of glaciers at the Rohtang pass that feed two major rivers: the Beas River, which flows through the Kullu Valley, and the Chenab River, which flows through the Lahaul valley. Once out of the Himalayas and in the great plains of south Asia, these rivers flow into the Indus River and form vital parts of the system that provides water to Punjab (literally, the "land of the five rivers") in India and Pakistan. Less snow here means less water in the rivers that irrigate the main food grain producing areas in both countries.

The Hindu Kush Himalayas – sometimes called the water tower of Asia – provide water to 10 major river basins in China, India, Pakistan, Nepal, Bangladesh, Bhutan, Afghanistan and a number of countries in central Asia. An estimated 1.3 billion people depend on the waters from these glaciers. They are at increasing risk due to climate change, which has caused the glaciers to recede.

> *"When we came here in May, after a gap of many months, we found the frozen body of a man inside the shed. He was a local bureaucrat, who must have got stuck in a blizzard while trying to cross the pass."*

I stood in a meadow next to the almost-4,000-metre-high Rohtang Pass, which connects the northern areas of Himachal Pradesh and the Ladakh region of Jammu and Kashmir to the rest of India. The rugged road, much loved by trekkers and motorsports enthusiasts due to its breathtaking views, used to be closed by the snows from November to May each year.

Officially, it still closes throughout this period. "But now we never know when it will snow and when it will not", said Sukh Ram, one of the men employed by the Indian Army's Border Roads Organisation to keep the pass clear. "Last winter, it didn't really snow till February, though we kept the pass closed as per orders. But now it suddenly started snowing a couple of weeks back [in early September]. We had to close the pass for three days, and so many people were stranded on the northern side."

In the meadow there was snow on the ground, which began to melt as the sunshine gathered strength and fell on the walls of a broken-down shed. "We shelter in that shed when there's a blizzard," said Ram. "This is a dangerous place. It gets very windy every afternoon – and you never know when a blizzard will strike. When we came here in May, after a gap of many months, we found the frozen body of a man inside the shed. He was a local bureaucrat, who must have got stuck in a blizzard while trying to cross the pass."

These dangers have always been part and parcel of life in the Himalayas. But life is getting more perilous, and in new ways. As the glaciers start to melt faster due to global warming, in many cases the waters accumulate just below the glacier, as the little stream that issues from the glacier's snout becomes unable to carry the extra water. These glacial lakes threaten to burst their banks as the water accumulates. Such glacial lake outburst floods – GLOFs, as they are called – have occurred a number of times in Nepal and Bhutan over the past 50 years, though there is no record of them before. Every time it means loss of life and property downstream. Scientists at the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD) say there are at least 36 GLOF threats right now in Nepal alone.

These are the immediate threats as the glaciers recede. In the longer term, the risk is that ice accumulation in these glaciers will occur at a rate slower than the melt, leading to the disappearance of at least the smaller glaciers from the Himalayan region. There are an estimated 9,000 to 12,000 of these small glaciers in the Indian Himalayas alone. Their disappearance, in turn, means rivers that now run throughout the year will become seasonal. The glaciers may contribute only about 10% of the total water flow in large river basins like the Ganges, but this is vital for perennial water flow and for water supply downstream in the dry months, when it is most needed.

Scientists say they do not know enough about what is happening to the Himalayas, especially the Himalayan glaciers, as a result of climate change. The last assessment report of the Intergovernmental Panel on Climate Change, published in 2007, described the area as data-deficient. Indian and Chinese scientists are now starting a large number of research projects to study the effects, including some joint projects. Meanwhile, the few weather stations that have been set up show that the rate of warming in the Himalayas is six times higher than the global average, says professor Syed Iqbal Hasnain, a leading glaciologist at the New Delhi-based The Energy and Resources Institute. India has just started a major research programme to study the Himalayan ecosystem, especially the way it is being affected by climate change. But many worried policy-makers say the time to act is now: they cannot afford to wait for the results of systematic scientific studies, which may take years. As Rajesh Kumar, a glaciologist with the Birla Institute of Technology Extension Centre in Jaipur, points out, even calculating the extent to which the temperature has gone upwill take years, since there were few weather stations in the Himalayas in the past.

Farmer Vikas Sharma had little doubt about the need to act now. "I don't know to what extent it's getting warmer," he said. "We don't have the sophisticated instruments to measure that exactly. But there's no doubt it's getting warmer and winters are getting shorter. We'll soon have to start growing other varieties of maize that don't need so much water. We know those varieties are not so good and we

won't get the same price in the market. But what's the option?"

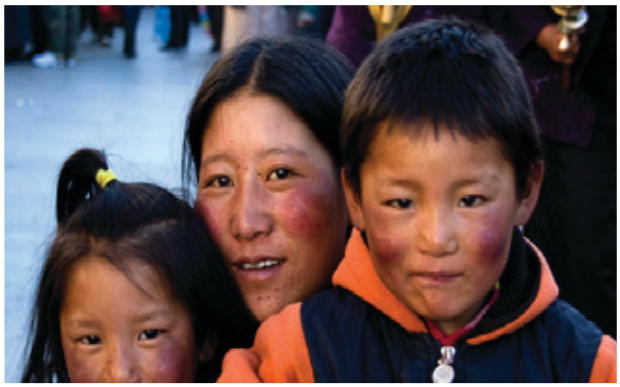
Joydeep Gupta is project director (south Asia) of the third pole project.

Image by Simply Czar

February 09, 2012

"Who are these people now?"

Tibetan herders are struggling to adjust to sedentary life on the edge of the city of Golmud. Xia Liwei visited one family and listened to their story.



Fifty-eight-year-old Sonka never dreamed he might one day leave his ancestral village of Cuochi, on the Qinghai-Tibet plateau, and move to the outskirts of Golmud, a largely Han Chinese city in northwest Qinghai province. Much less did he imagine his family's entire way of life would change.

An unaffected smile brightened Sonka's dark face as he welcomed me warmly into his home. His wife and daughter served tea and snacks, while Ouyao, a member of the staff at local NGO, Snowland Great Rivers Environmental Protection Association, translated Sonka's explanation of how he came to live in Golmud.

In 2005, this family of five, together with almost 300 other herding households from Sanjiangyuan – Qinghai's "Three Rivers Source" area, which contains the headwaters of the Yangtze, Mekong and Yellow River – were relocated to a settlement eight kilometres south of Golmud. The move was part of the government's "ecological migration" scheme, designed to protect the region's delicate environment.

Sonka agreed to move after local government officials told him that herders pose a "threat to the grasslands", along with the plateau pika, a small mammal considered a pest for competing with other species for food and degrading the land. If moving would be good for the grassland, Sonka said, he was willing to do so. He arranged for someone else to look after the family's several head of cattle – this would provide some extra money for the family, and also give him a way to return to the village, should he wish to, a decade down the line.

"So, have the grasslands improved since then?" I asked.

"Yes. I go back several times a year, and the grass is looking better and better," Sonka replied.

For Sonka, another advantage of the move is that his children can go to school more easily. In Cuochi, the elementary school only went up to third grade, and both facilities and teaching were poor. Now the children can go to the elementary school over the road and, later, to middle school in Golmud – no matter what other challenges they face, education here is better than in Cuochi.

> *"In Cuochi, the family had meat and milk from their own cattle, used dung for fuel and wore homemade sheepskin clothing. They rarely needed cash."*

That doesn't mean everything is perfect, however. In fact, the family has plenty of complaints about the local schooling. They have various fees to pay, adding up to 300 yuan to 400 yuan (US$48 to $63) over the year, and Sonka thinks the teachers are too casual about their lessons: one took three weeks sick leave and there was no supply teacher to fill in. His youngest son used to attend the school, but there were so many holidays and so few classes that they worried he wasn't learning anything. Instead, they

sent him to a Buddhist orphan school, much further away from home.

Sonka's daughter, Wurong Zhuoma, was in fourth grade when she moved schools. She whispered to us that, after a year in the new place, her legs and arms were covered with marks where the teacher had hit her. She said she was too scared to tell her parents in case the teacher found out and hit her more. Not one student in the class had escaped the teacher's blows, she said.

But Sonka's biggest worry is that the family is spending more money than it brings in.

The government pays each relocated family an annual subsidy of 8,000 yuan (US$1,266). When they first moved, Sonka thought such a large sum would be enough to feed and clothe all five of them. But he soon found out that, in the new village, everything costs.

In Cuochi, it was different: they had meat and milk from their own cattle, used dung for fuel and wore homemade sheepskin clothing. They rarely needed cash. The family was also used to having meat at every meal, but they can't afford to buy it at the market in the new place. Sonka keeps in touch with relatives back in Cuochi, and asks them to bring beef or mutton when they visit. And when he goes to Cuochi, he brings back as much meat as he can carry.

Sonka is uneducated, unskilled and can't speak Mandarin. The only work available to him is basic labouring – construction work, for instance, or moving goods. It's tiring and the hours are long, and Sonka is often the oldest worker on site. But the family needs the money.

When caterpillar fungus – an ingredient used in Chinese medicine – is in season, the family goes out to pick it. Sonka's sons are fast diggers and can collect a lot. His daughter also works in a hotel. Between the fungus harvesting and the hotel work, the family makes around 8,000 yuan, but after paying a fungus-collection fee of 1,500 yuan per head, they end up clearing only 2,000 yuan (US$316).

The other families in the village face the same problem: a serious shortage of money. I met Kangzhuo, a nun from a Sichuan nunnery, who was visiting her sister. She said she was disgusted with conditions here: "There's no grasslands, no cows and no sheep – what have they got? Just a cramped house!"

She pointed at the wasteland surrounding the village. "Who are these people now? They're not Tibetans and they're not Han. If they were Tibetan, they would have grasslands and livestock; if they were Han, they could speak Mandarin and work. But they can't herd, and they can't work."

Standing in front of an empty house, she continued to complain: "There's a government regulation saying you can't sell these houses. But, if the herders can't survive here, what else are they meant to do? Some people have sold their houses anyway, at a very low price."

The relocation policy states that, after 10 years, the herders can decide whether to stay in their new homes or return to their villages. Most say they want to go back. They say they miss the grasslands and life in the new village is tough.

Ma Wenqing is head of the Qumalai county office in Golmud. He said many of the problems in the new village are related to the hukou,or household registration system. Because they are still registered in their home village, the herders are only entitled to free or subsidised healthcare at Qumulai County Hospital, for instance, and making the trip there and back costs 500 yuan (US$79). Ma has encouraged the herders to shift their household registrations to Golmud, saying this would not only bring them preferential treatment, but also make it easier to implement and report on infrastructure projects.

In the nearby Yangtze River village, where residents are already registered in Golmud, the conditions

are much better – they even have sports facilities. But Sonka explained that, because many people are reluctant to leave their native land, they are also reluctant to change their registration. "It's like betraying your home," he said. And so the problem has not been resolved.

After meeting Sonka, I asked myself whether the relocation policy is worth the sacrifice each member of his family – and others like his – has made. Will it bring them happier lives? Will it protect and preserve the precious Tibetan culture and its simple values? If the answer to these questions is no, then the ecological migration policy should be re-examined.

Xia Liwei was a 2010 participant in the project Grassland Tribes.

Image by Fan Mingxiao

February 10, 2012

Love story of the black-necked crane

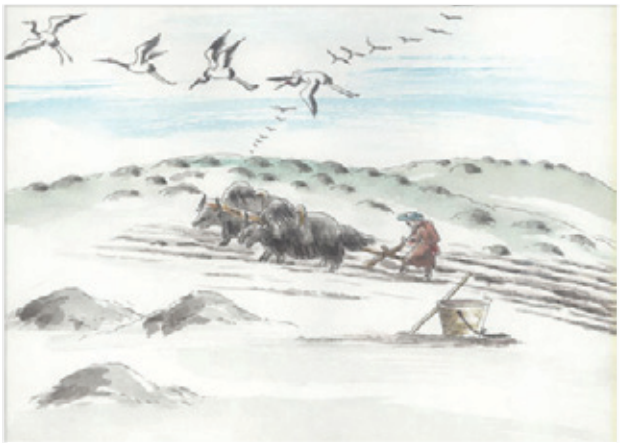
With this tale of loss, narrated through a series of drawings, Tashi Sange explores people's relationship with nature in the shifting climate of China's far western plateau.

Tashi Sange is a Buddhist khenpo (scholar) at Baiyu Monastery in Golog, Qinghai, and the founder and head of the Nianbaoyuze Environmental Protection Society. He has become a local legend in Qinghai for his efforts to protect – and to paint – the region's birdlife. In this series of pictures, drawn especially for chinadialogue, he shares a folk tale about one of Tibet's sacred birds, the black-necked crane.

My home is in Golog prefecture, Qinghai, to the south of the Nianbaoyuze Mountains. There is a huge wetland there, called Narangsang. A relative of mine, Morao, lives by that wetland, and he told me this story. It happened decades ago.

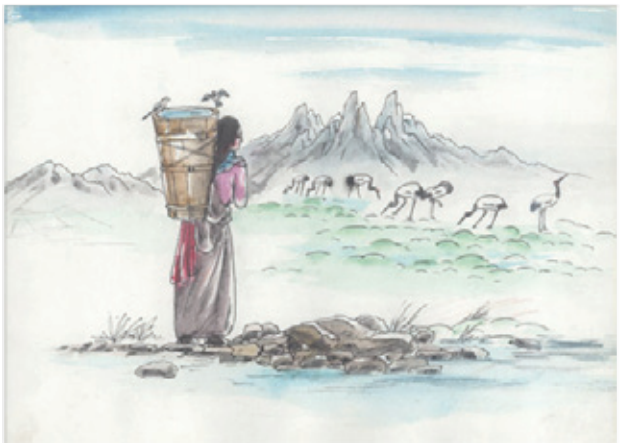
Images by Tashi Sange

LOVE STORY OF THE BLACK-NECKED CRANE

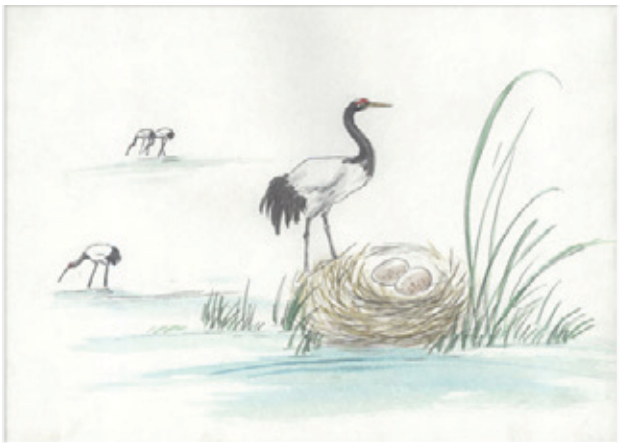


In summer, the Narangsang wetland is very dangerous *and people and livestock stay away. Anyone who strays there is liable to disappear without trace – that is, until their bones surface years later. And so the wetland becomes a paradise for black-necked cranes: hundreds of them gather here every summer to breed. They used to arrive in May or later. By then, the herders had started working in the fields and had lined up piles of cattle dung to use as fertiliser.*

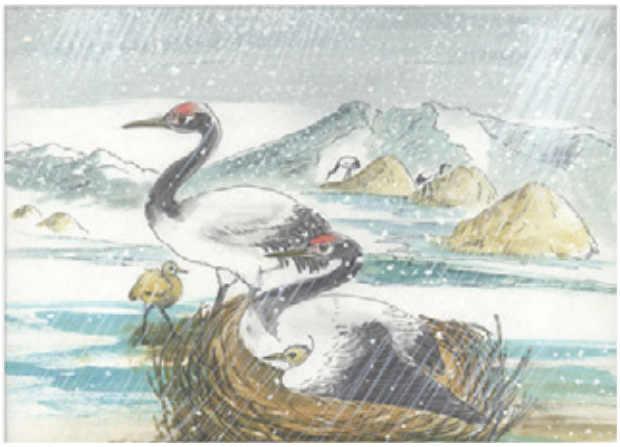
Locals say the cranes used those piles of dung as landmarks. But now the birds arrive in March, before the herders have moved to their summer pastures. Perhaps because they have no dung to guide them, they have changed their migration route. The herders say the weather stays warm for longer and the cranes now leave in November instead of October. The shifting climate may also be why their numbers have fallen – now only 30 or 40 come to the Nianbaoyuze Mountains each year.



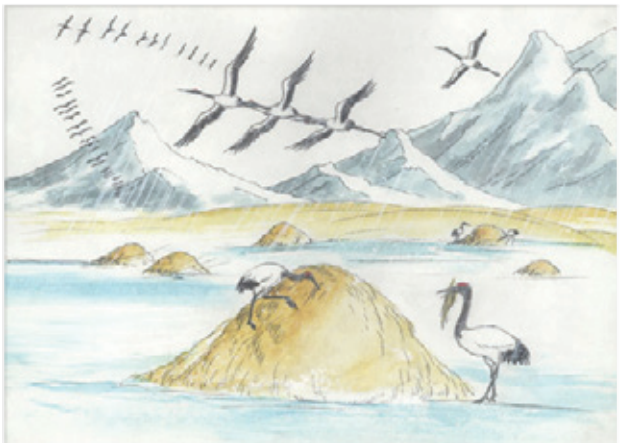
A traditional Tibetan wedding may see a girl married off to a family in a faraway village. Sometimes, she will never return. The cranes arrive in summer and leave in autumn, and live near the herders' homes. The herders know the routes the cranes take. The girls see the cranes flying from their own village and sing songs of home.



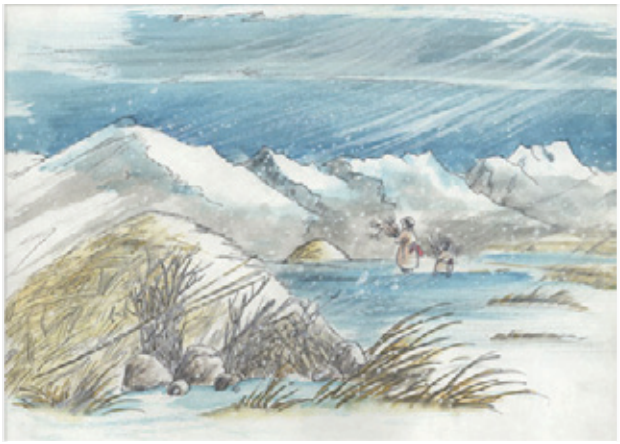
When they arrive, the cranes form large groups, but gradually pair off. Usually, each pair produces two eggs, but only one chick will likely survive.



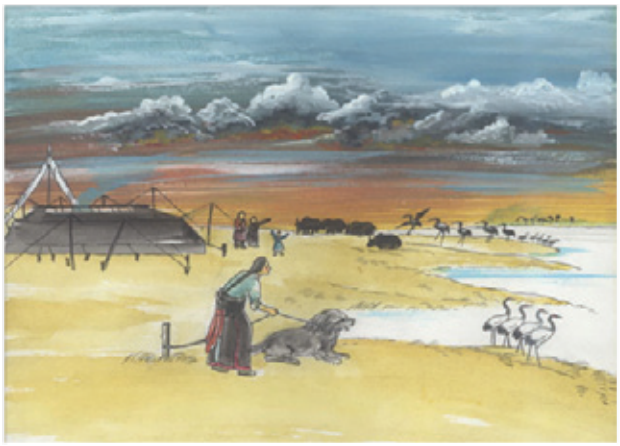
Sometimes they arrive late, and so the chicks also hatch late. Winter arrives before they have grown.



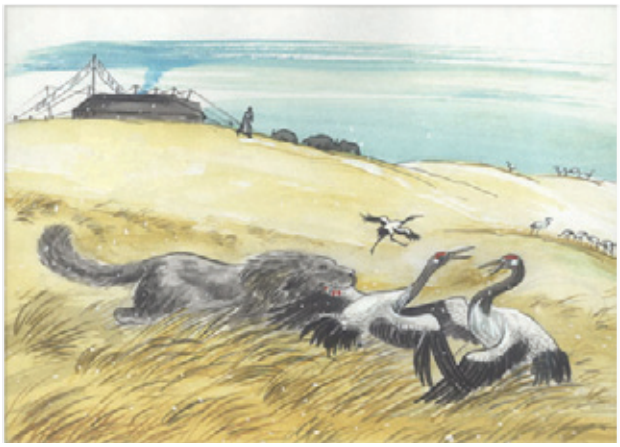
The chicks can't migrate, and so their parents cover them with a pile of grass and leave them to spend the winter alone.



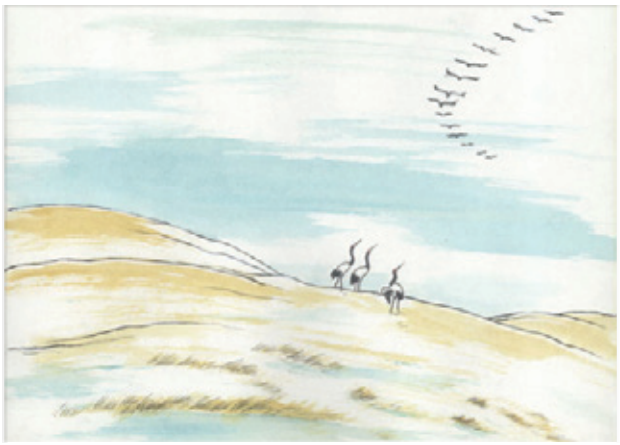
The strong winter winds can blow the protective grass away, leaving the chicks to freeze to death. The herders worry when they see the cranes arriving late. When winter arrives, they help out by weighing the grass down with scrub and stones. The black-necked crane is one of Tibet's three sacred birds (the others are the raven and the magpie). Children hope to grow up to be beautiful like the cranes and to travel to distant places. The herders won't hurt the birds – they believe it would bring disaster upon their family. And so the cranes here aren't scared of people.



In winter, the wetlands near the summer pastures freeze over. To keep cattle and dogs from getting into the wetlands and destroying the nests, the herders move away before the ice forms. In the past, the herders would have done anything for the birds, but these days the younger ones don't care and put their livestock first. The cranes all leave on the same day. The day before they go, they spend the night near the herders' homes. As their migration approaches, they look to the sky and call out. The herders know they are about to leave, and often come out of their homes to watch them. The herders tie their dogs up to prevent them from harming the cranes.

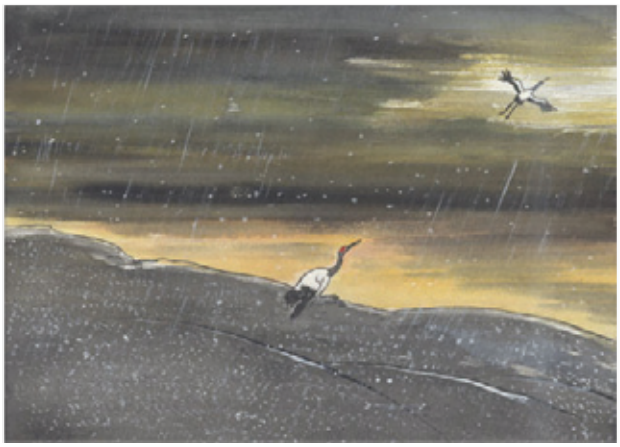


One year, Morao's dog wasn't tied up properly and it bit a female crane. The bird's mate rushed to protect it and together the birds scared the dog away. Their chick fled in fear.

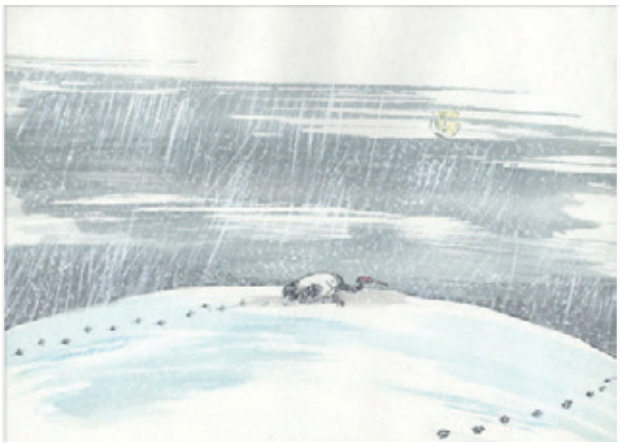


The next morning, the flock was ready to leave. But the injured bird and its mate couldn't go. They looked to the sky. The other cranes circled, landed and took off again. They came back several times, but eventually flew away.

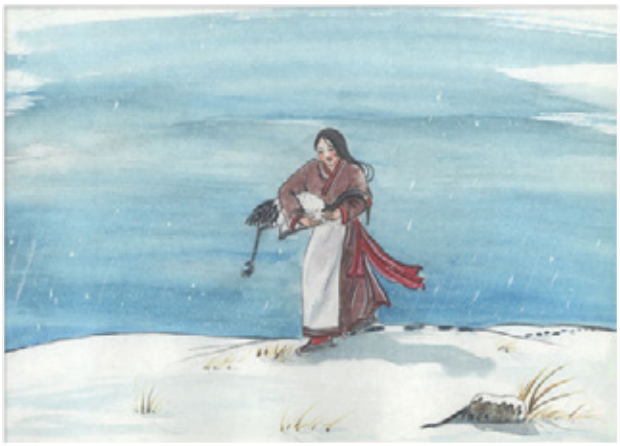
In the afternoon, the family's chick also left.



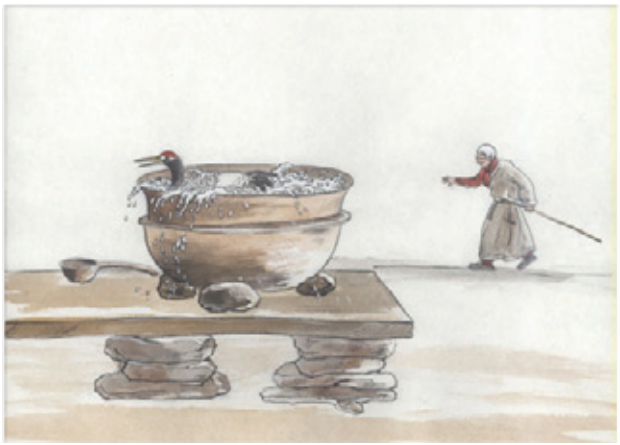
The injured bird was worried about her chick and squawked at her mate to fly after it. Hesitantly, he did so – but returned several times. Finally, as night fell, he flew away, leaving his injured mate behind.



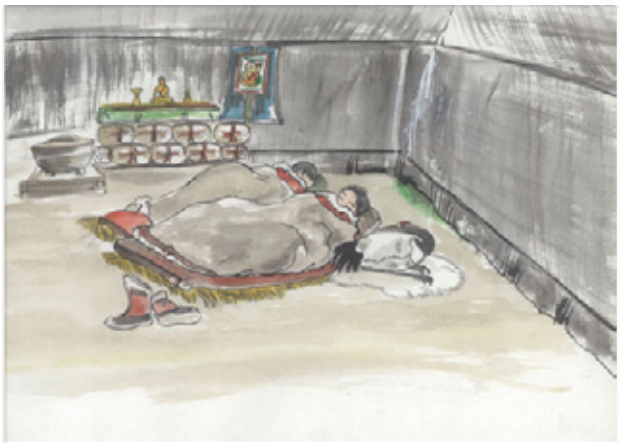
It snowed that evening. The herders searched for the bird, worried that a wolf or a fox would kill it. But it was nowhere to be found. They were also worried for the two that had left – would the chick find the flock? Would its father catch up with it? They prayed for their safety.



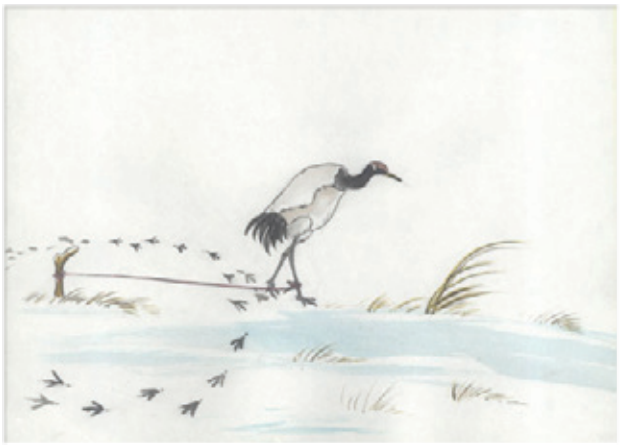
The next morning, Morao's daughter Naji finally found the injured crane and took it home.



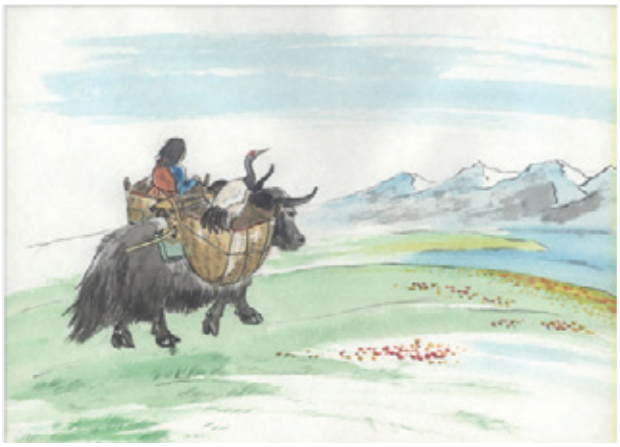
The family immediately put it in a pot of warm milk. It was badly hurt, and covered in oil and dirt. Its once black and white feathers were greasy and grey.



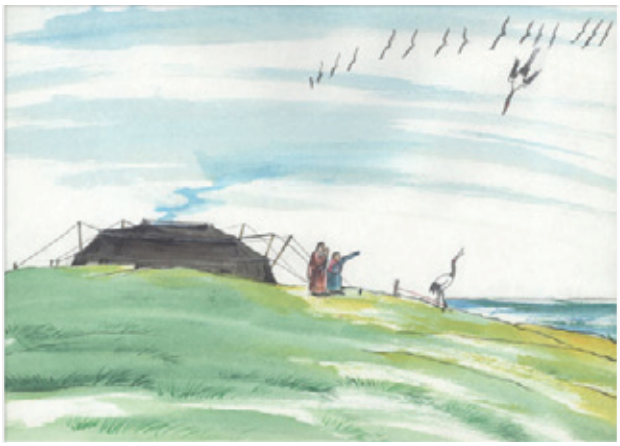
Fortunately, the family lived near a lama who knew Tibetan medicine and treated the bird's wounds. But it couldn't fly, and its oily feathers couldn't keep it warm. The herders made the crane some woollen clothes, and at night it slept in the same tent as their children.



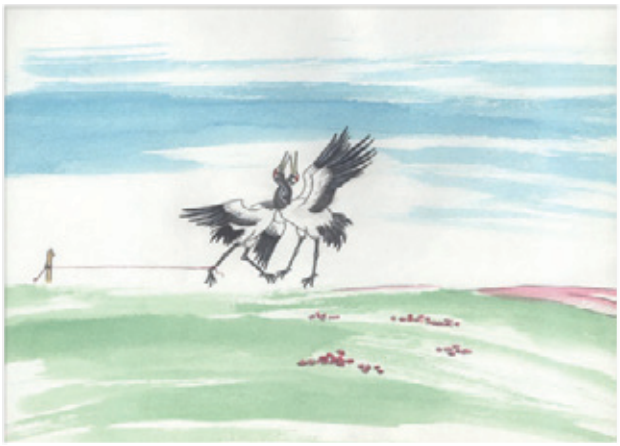
To stop it from wondering off and being bitten again, they tied the bird up. It could only walk as far as the rope would allow it, and looked dismal in its grey jacket. And so the crane passed a long slow winter.



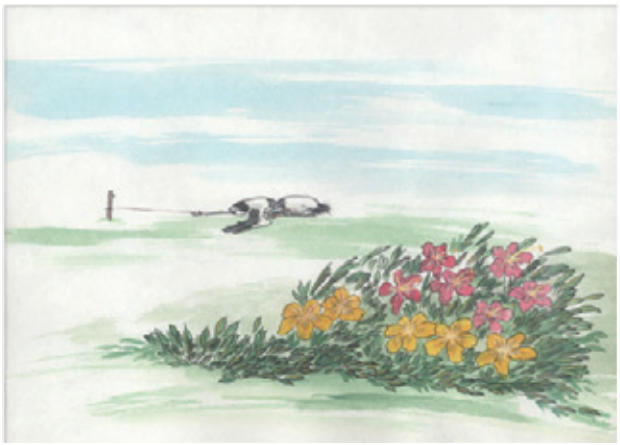
As the spring flowers opened, the herders moved again. They put the crane in a basket on the back of a yak and took it to the summer pastures.



One morning, the crane started to call to the sky – the first time it had made a sound since being hurt. The herders guessed that the flock was returning and they ran out to look. After a long while, the flock arrived. As it flew overhead, one of the birds dived from the sky and landed by the injured creature.



The herders recognised it as the bird's mate. The two cranes intertwined their necks and called out in unison, and then fell to the ground, silent.



The herders looked on from afar, but the birds didn't move. When they got closer, the herders found both birds had died.

The Tibetans say that for a person, sadness lasts at most a year, but for a bird it lasts a lifetime. A person will not mourn a relative for long, but a bird's pain will stay with it until death.

Part 6: Urbanisation and development

In recent decades, rapid development in the highest inhabited areas of the world has made the third pole region even more vulnerable to natural and man-made disasters. This section provides highlights from thethirdpole.net's series on urbanisation in the Himalayas, in which local journalists provide first-hand accounts of the growing pressures affecting urban areas in the region. Ramesh Prasad Bhushal describes the deepening water crisis in Kathmandu, where pollution is destroying rivers and groundwater overuse is literally sinking the valley. Dawa Wangchuk offers a rare glimpse into the reality of the Kingdom of Bhutan, where the capital Thimphu is sacrificing its own environmental resources in a furious endeavour to catch up with the modern world. And Liu Jianqiang travels to Lhasa, where he sees the impact of breakneck development in the wake of the construction of the Qinghai-Tibet railway.

A more profound development boom is coming to the Tibetan Plateau, a region that holds the key to China's accelerating demands for water and minerals. Jiang Yannan and He Haining write that construction of a massive dam on the Yarlung Zangbo marks a turning point for Tibet. And Gabriel Lafitte raises concerns about the impact of large-scale mining on the plateau.

Urbanisation and development
Contents

May 31, 2011

The dead rivers of Kathmandu

Urban sprawl is driving a deepening water crisis in Nepal's capital. *Ramesh Prasad Bhushal* *reports.*

Putting his hands on his forehead, 70-year-old Sadhu Bhai Maharjan explained how he and his friends used to swim in the Bagmati River, a few minutes walk from his home in Kalimati, at the centre of the Kathmandu valley. The valley has witnessed rapid urbanisation in the last few decades and Maharjan is among the few people still engaged in agriculture for their livelihood in the core of Nepal's capital.

Clipping small bundles of vegetables, he said: "Now people don't believe us, but we used to swim in the river flowing nearby a few decades back and enjoyed fishing. The water was used for drinking too." These days, almost all rivers of the valley, including Bagmati – the holiest of them – are as good as dead.

His neighbours, who were farmers until a few years ago, have shifted to urban life. The owner of the large chunk of land next to Maharjan's plot decided to lease it to a college two years ago. A huge building stands there now. "We used to bathe in the river before the crack of dawn and foxes used to howl at night. Those days are no more than memories now," Maharjan added, while the stench of garbage swept in from the river.

Here, large sewerage pipes act as tributaries to the rivers, as most nearby dwellers dispose of their sewage directly into these streams. All rivers in the valley have been turned into dumping sites. The worst have become narrow canals, as more and more people encroach on the riverbeds. The population of the 899-square kilometre valley has increased fivefold in the last 60 years, from 197,000 people in 1952 to 997,000 by the time of the 2001 census. Meanwhile, the built-up area has increased by 134%, from 24.54 square kilometres in 1989 to 57.32 square kilometres in 2006.

Scientists have declared the rivers "dead" as hardly any fish can survive in them anymore. Recent studies show that the fish population has been completely wiped out in the 10-kilometre to 15-kilometre stretch of the Bagmati River that flows through the city centre. And this is Nepal's holiest waterway, which flows past the Pashupati Nath Temple, one of the most sacred Hindu shrines in the world.

> *"We used to bathe in the river before the crack of dawn and foxes used to howl at night. Those days are no more than memories now."*

Not only is the surface water polluted, groundwater depletion is also very high. Siddhartha Bajra Bajracharya is executive officer at the National Trust for Nature Conservation (NTNC) and team leader of the Bagmati River Action Plan (2009-2014). He said: "Most of the water [of the Bagmati] has been tapped for drinking purpose near the source of the river in Shivapuri National Parks hills in the north-west of the valley and the 'concretisation' has restricted the groundwater from recharging [further downstream]. This has caused the drastic reduction in the flow of water in the rivers of the valley."

The valley requires around 220 million litres of water every day; but the supply is less than half of that – approximately 100 million litres a day. And an estimated 40% of the water supply is lost through leakage from old, rusty and broken pipes. The shortfall is met by people pumping out groundwater themselves. Experts are warning that, if the present groundwater extraction trend continues, then the soil of the valley itself may subside within a few decades.

"Our study has revealed that the groundwater table has been dwindling by 0.7 to 1.7 metres a year," said Nir Shakya, senior hydro-geologist on Nepal's Groundwater Resources Development Board. "This is an alarming trend. The valley is becoming more prone to subsidence." Subsidence – the sinking of land caused by excessive groundwater extraction – is a common problem in cities that swell in size without any water regulation or proper infrastructure. But Nepal's government still has no plan to address the problem.

Water is not the only natural resource at risk in this beautiful country of high mountains and panoramic vistas. Massive deforestation and rapid, poorly planned infrastructure development have become critical threats to flora and fauna. The bird population in the valley is dwindling at an alarming rate. "The habitable banks of rivers have turned uninhabitable, which has reduced the water bird population by at least 90% in the last two decades. Other birds are also facing a huge threat," said Hem Sagar Baral, senior ornithologist at conservation institute Himalayan Nature and writer on the birds of Nepal.

The only good news is that many years ago conservationists persuaded the Nepali authorities to declare the sandstone mountains which encircle the valley as an official protected area. So the mountains from Phulchowki in the south-east, Chandragiri and Champa Devi in the south-west, Shivapuri in the north-west and Nagarkot in the north-east have been preserved. Today, the people of Nepal earn more money from tourism in these areas than they would have if these mountains had been covered with concrete. Perhaps that will convince the authorities that, in the long run, preserving the environment profits everyone.

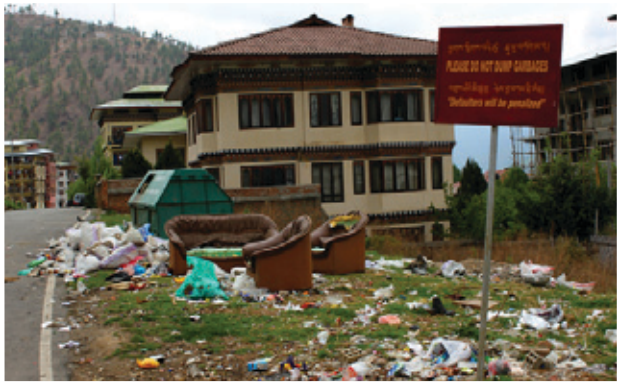
Ramesh Prasad Bhushal is a Kathmandu-based journalist.

Image by Phil @ Delfryn Design

May 31, 2011

Bhutan's modern face

Thimphu, the kingdom's fast-developing capital, is one of the cities most vulnerable to climate change in the world. But it is unprepared for the crisis, reports Dawa T Wangchuk.



Over the past few decades, Thimphu – the capital of Bhutan – has transformed from a beautiful little town into a modern, concrete city. But urban expansion has come at the cost of severe environmental degradation.

Climate change is putting the city at even greater risk. Thimphu is one of 15 cities in the world most vulnerable to the impact of global warming, according to a recent report by the International Institute for Environment and Development, a London-based research organisation.

The city sprawls down steep slopes between altitudes of 2,248 metres and 2,648 metres. Thimphu's sharp inclines – many with gradients greater than 30% – make the city particularly vulnerable to landslides. Heavy rainfall and sudden cloudbursts, which increase the risk of landsides, will become more frequent as a result of climate change, according to the Intergovernmental Panel on Climate Change (IPCC) 2007 assessment report.

Thimphu's urban development began at a slow pace in 1961, with the launch of Bhutan's first Five-Year Plan. But it was not until the kingdom opened its doors to the outside world in the 1970s, that the process of urbanisation really started to take hold. Since then, there has been considerable construction in the city centre and suburban development has mushroomed.

According to Bhutan's National Statistics Bureau, Thimphu had a population of 104,214 in 2010, and is growing at a rate of 1.3% every year. Thimphu will continue to expand in the future, as migration from villages to the city becomes ever more popular.

The environmental effects of this urban expansion are visible to anyone who visits the capital. In the past, ecologically rich wetlands were interspersed with the city's buildings – visible by the swimming pool complex and the Changlimithang Stadium, south of the sewage-treatment plant in Babesa, near the cremation ground by the river and next to the settlement of Langjophaka. Today, most of the wetlands have been converted into residential areas, shopping complexes, sports and recreational spaces. Only a few remain, but they too are at risk of disappearing.

> *"Thimphu's steep slopes – many with gradients greater than 30% – make the city particularly vulnerable to landslides."*

Predictably, urbanisation has had a negative effect on flora and fauna. Wood snipes, once common in Thimphu, have not been seen since 1999, according to ecologist Rebecca Pradhan from Bhutan's Royal Society for Protection of Nature.

Waste management has always been a problem in Thimphu, but the situation has deteriorated with the expanding population. According to Thimphu City Corporation records, the capital of Bhutan produced about 18,000 tonnes of waste in 2009, which means almost 50,000 kilograms every day. The waste-

management system is already struggling to cope, but it is estimated that, by 2020, some 81,000 kilograms of waste will be produced every day.

In 2009, local waste comprised mainly organic materials, as well as some paper and plastic. But now electronic waste – particularly refrigerators, computers and mobile phones – is being dumped out in the open along with other waste, increasing the risk of dangerous chemicals leaking into soil and downstream water supplies.

With more and more Bhutanese settling in Thimphu, the numbers of vehicles are increasing too. Of the 53,382 vehicles in the country, 29,139 are in Thimphu and major cities in the west, according to the Royal Bhutan Police Traffic Division. Higher vehicle numbers have led to a higher demand for road construction in the fragile mountains, and increased traffic on the 11-kilometre Thimphu-Babesa expressway has destroyed many bird habitats. The ongoing river diversion work on the Thimphu River has also resulted in further destruction of bird habitats.

According to the National Environment Commission, Thimphu and the town of Phuentsholing on the border with India have experienced deteriorating air quality over the years. Daily air-pollution levels now often exceed WHO guidelines. Sources of air pollution include combustion of biomass and fossil fuels, industrial emissions, dust from unpaved roads, new construction sites and bitumen heating for road construction.

Houses in Thimphu are poorly designed when it comes to storing heat during the cold winters. Improving building design could save energy and money in the long run. If building designs are improved, energy consumption could be drastically reduced. For example, in an average household, windows account for 15% to 30% of the total heat loss. Well-designed, large glass windows could save energy through the benefits of passive solar heating. While the initial cost of installing double-glazed windows is high, by reducing energy loss by up to 18%, such a move would eventually pay for itself. Advanced insulation materials can reduce the energy consumption of buildings by as much as 90%, according to the architect Herbert Girardet.

Although such solutions are available, they are seldom used, while the capital of this remote country hurtles to catch up with the rest of the world.

Dawa T Wangchuk is a reporter for Business Bhutan, the country's only financial newspaper.

Image by Iupic

October 13, 2006

Preserving Lhasa's history

The Qinghai-Tibet railway brought a wave of travellers to Lhasa. But many found a city threatened by irresponsible tourism and breakneck urbanisation, says Liu Jianqiang.

At over three and a half kilometres above sea level, Lhasa is the world's highest city. Many people decide to visit this enchanting place, known as the "holy city in the land of the snows".

On July 1, 2006, the Qinghai-Tibet railway opened and crowds of people from China's cities clambered aboard to visit the place they had dreamed of – including my friend, Tian.

Tian is a journalist with the Xinhua news agency, and had always wanted to visit Lhasa. At the end of August, Tian boarded the train to Tibet. But three days later he returned, deeply disappointed. Hotel prices had rocketed – a decent, reasonably-priced room was almost impossible to find. "And it was boring," he added, "just the same as any Chinese city." The tall buildings, congestion, noise and street hawkers had left his dream in ruins.

Nor is he the only one disappointed. A scientist friend from Peking University went to Lhasa in mid-August hoping to buy a Tibetan-style courtyard home – she imagined leaving behind the bustle of Beijing, sipping sweet Lhasa tea with a view of the Potala Palace. But Lhasa's reality did not match up to her vision. Property prices had risen; the money which would previously have bought her a courtyard would only purchase a single room. Tall buildings crowded a skyline where once even four-storey structures were rare, blocking the view of Lhasa's iconic Potala Palace.

In the seventh century, Songtsen Gampo unified Tibet and moved the centre of political power from Shannan to the site of present-day Lhasa – pastureland at the time – and founded the powerful, slave-owning Tubo Kingdom. He also built the Jokhang Temple, Ramoche Temple and the first Potala Palace. Legend has it that Songtsen Gampo used soil carried to the site by goats to build the Jokhang Temple and the city was thus named "Resa", from the Tibetan words for soil (re) and goat (sa). With the adoption and rise of Buddhism, the number of pilgrims rose steadily. Hotels, shops, homes and administrative centers sprung up around the Jokhang Temple, forming the circular street known as the Barkhor. As Buddhism flourished, the Tibetan people started to call the city Lhasa, which means the "holy city" or "place of the Buddha".

"*Tall buildings crowded a skyline where once even four-storey structures were rare, blocking the view of Lhasa's iconic Potala Palace.*"

In the mid-17th century, the Qing emperor authorised the Fifth Dalai Lama, Lobsang Gyatso, to consolidate his political and religious power, with Lhasa as the centre of government. The Potala Palace was rebuilt to a height of thirteen storeys – almost 120 metres – and became the residence of the Dalai Lamas, seat of their political and religious rule and a landmark on the Lhasa skyline.

The Potala Palace makes a great visual impact as you first arrive. In 1936, F. Spencer Chapman, a member of the British Government's mission to Lhasa, wrote in Lhasa, The Holy City: "Unlike any other building in the world, the Potala has the presence of a New York skyscraper and a subtle similarity to the Pyramids of Egypt…not only are the design and color of the building breath-taking in their beauty, it is also of enormous size. This majestic beauty can best be appreciated in the government park below the Potala." But for Tibetans, the Potala's impact is not merely visual. Karma, from Tibet's Chamdo region, told me of how he wept and prayed when he first glimpsed the Potala. Many Tibetans have similar tales to tell. For them the Potala is not just a building, it is the home of their faith – and it is this which makes Lhasa holy.

It was in the 17th century that Lhasa first started to evolve into a city. Official residences, mansions, guesthouses and shops were built flanking the Barkhor, but on a small scale. As late as 1906, there was only a small residential area near the Jokhang. The city had expanded by 1935, when the "Snow Village" residential district was built in front of the Potala. But by 1950, Lhasa still had a population of only 30,000 and covered less than three square kilometres, with dirt roads and no sewers.

It was later that the process of urbanisation really started to take hold. By 1975, Lhasa covered 18 square kilometres and had a population of 100,000. According to statistics from the city government's website, Lhasa is now 18 times the size it was in 1959, with a quarter of a million people living in the urban area (100,000 of those migrants). Locals have told me that since the opening of the railway and the arrival of many more wealthy people, the actual population has already risen far beyond that figure.

Some examples may help to illustrate the changes in the city. For instance, when Chapman visited Lhasa 70 years ago, he described seeing women dumping all kinds of rubbish in front of the Potala, forming 10-foot-high piles by the roadside. When I visited in May, the Potala was fronted by a huge, clean plaza.

But before 1959, the Potala was a solemn and sacred place. Now it is a tourist attraction. Another friend of mine from Beijing took the train to Lhasa in July. When she set foot in the Potala it wasn't the architecture, the culture or the history that struck her – it was the hordes of touristsstreaming like termites over the wooden floors. Previously, visitor numbers were limited to 850 a day in order to protect the building, but this number was raised to 1,500, and then to 2,300 visitors a day once the railway was opened – earning huge amounts of money for the Potala's managers.

Today it is still the sight of the Potala Palace, perched on top of the Red Mountain, which heralds the traveller's arrival in Lhasa. But as you get closer to the city it becomes lost behind modern buildings. Buildings and roads named after places in northern and eastern China roll past – Jiangsu Road, Beijing Road, Shanghai Plaza and Shangdong Mansion. You may find yourself asking whether you are in Lhasa at all.

Once a "holy city" of unique tradition, Lhasa is undergoing huge and very complex changes – some bad and some good.

Balancing tradition with development

Karma arrived in Lhasa in the winter of 1986, cold and hungry after a 10-day journey on the back of an open truck. His first act was to complete a circuit around the Jokhang Temple, weeping as he prostrated himself. Karma then worshipped in the temple – something all Tibetans aspire to do.

Karma stayed in Lhasa, and is now one of Tibet's most successful businessmen. Pilgrims like Karma, who end up staying in Lhasa, form a part of Lhasa's growing population. But a bigger spur to Lhasa's growth has been the increase in governmental, industrial and commercial activity. An elderly Tibetan told me that

in 1950, there were so few Han households that he could name them all. Nowadays, you can take 10 taxis in Lhasa, and eight or nine of the drivers will be from the mainly Han Chinese province of Sichuan.

On a mid-May afternoon I stood on a road running between the Potala Palace and the Jokhang Temple. In 10 minutes, over 100 people passed me by, but not one was wearing traditional Tibetan clothes. Some of those passers-by were Tibetan, but it was as if they had abandoned their dress and their culture.

Lhasa has already abandoned enough. When Karma first arrived, almost all traditional Tibetan buildings – religious and secular alike – were still intact. Two decades later, only one-third of the traditional-style secular buildings still stand.

"Lhasa's personality is changing," said Dawa Tsering, head of WWF's Lhasa office. He told me that Lhasa's architecture should represent the city's unique cultural values, but local tradition is being ignored. Lhasa is being developed in the same way as Beijing or Shanghai, as part of a quest for modernisation.

Tsering admitted that tradition could not always be completely retained. For instance, traditional Tibetan buildings tend to lack light and space. But this is no reason to abandon them entirely – a redesigned interior which still retains the external appearance could make Tibetan buildings suitable for modern living.

A Tibetan sociologist, who declined to be named, said that the demise of Lhasa's traditional architecture can be put down to the sources of investment in the city. Most funding comes from Chinese investors in faraway provinces. For instance, Jiangsu Road was built with money from eastern China's Jiangsu province, whereas the Lhasa People's Hospital was paid for by Jiangsu province, Beijing municipality and the Ministry of Health. Provincial and government support for infrastructure construction is no bad thing, but it's difficult to ensure it will produce Tibetan-style buildings.

The sociologist added that in the past two decades, failures in urban planning have lead to the excessive outward expansion of the city. In 1992, Lhasa relaxed its restrictions on private construction, leading to a building boom fuelled by property developers. Many residents relocated to the outskirts of the city. A new district arose to the west of Lhasa, devoid of any Tibetan characteristics. Many Tibetans from outside Lhasa moved into the city, buying and building houses. And although these buildings do have some Tibetan characteristics, they lack any overall planning or proper sewage treatment facilities.

> *"In 10 minutes, over 100 people passed me by, but not one was wearing traditional Tibetan clothes. Some of those passers-by were Tibetan, but it was as if they had abandoned their dress and their culture."*

Over recent decades, Lhasa has been marching towards "modernisation". According to the city government's website, average per capita housing space has risen from 7 square metres in 1959 to 25 square metres today. Government investment has brought infrastructure construction and has funded the preservation of the Potala Palace and Lhasa's temples. But the city has grown too rapidly, leaving sewerage, roads, electricity and telecommunications infrastructure struggling to keep up. Lhasa has recently built an up-to-date solid waste treatment plant, but there is still no such facility for sewage – which is discharged raw into the Lhasa River, known as the mother of the Tibetan civilisation.

There are also issues with the ethnic layout of the city. A survey by Peking University found that Han and Tibetan populations keep to their own districts, limiting interaction between the two groups. This segregation also affects children, who are likely to attend schools close to their own homes. Tibetan residents in the old city tend not to have Han friends

or neighbours, Han people are often ill-informed about Tibetans.

Lhasa has already expanded as far as it can, so these issues will have to be resolved within the current city limits. And bringing two populations together is not as simple as adding Tibetan features to buildings. The real challenge is how a traditional culture can survive in the modern world. Karma says that the biggest threat to Tibetan culture is not the influx of Han Chinese – it's globalisation. Businesses from Lhasa and elsewhere are turning this holy city into a marketplace. The Potala Palace and many of Lhasa's temples have become commercialised and monks are being tempted back to a secular life. Tibetans have put away their traditional clothes, and money has become paramount as young farmers and nomads leave the land for the city lights.

People like Karma have started trying to save the city's culture, not by rejecting Lhasa's commercialisation, but trying to make it work for Tibetan culture, not against it.

Karma answers the phone in English, but keeps his hair in Tibetan-style braids and often wears Tibetan clothing. Most importantly, he retains his kind heart, his honesty and his Buddhist faith.

Karma is working to establish the first five-star hotel in Lhasa. In talks with the chief executive of a major international hotel chain, he requested that the proposed hotel should keep to traditional Tibetan designs, and that it should face the Potala. The American executive sneered: "Our guests want to stay in a hotel, not your Potala Palace." But Karma retorted: "Guests will come from around the world to see Tibetan traditions – not your hotel."

Whether this city remains sacred will be determined by people like Karma, and whether the government will adopt the same attitudes to tradition, faith and modernisation that he holds.

Liu Jianqiang, born in 1969, is a senior reporter with Southern Weekend and has a long-standing interest in environmental issues.

Image by wanderfolly

January 17, 2011

A new era for Tibet's rivers

Construction of a massive dam on the Yarlung Zangbo marks a turning point for Tibet, write He Haining and Jiang Yannan. A development boom is coming.

The rushing waters of the Yarlung Zangbo, the last of China's great rivers to remain undammed, will soon be history. On November 12 last year, the builders of the Zangmu Hydropower Station announced the successful damming of the river – the first public announcement on a matter that, until now, has been kept under wraps.

The Zangmu hydroelectric power station is being built on the middle reaches of the Yarlung Zangbo (known as the Brahmaputra when it reaches India) between the counties of Sangri and Gyaca. Around 7.9 billion yuan (US$1.2 billion) is being invested in the project, located in a V-shaped valley 3,200 metres above sea level. At 510 megawatts, the plant is much smaller than China's 18,000-megawatt Three Gorges Dam, but still equivalent to the entire existing hydropower-generating capacity of Tibet.

The construction workers have now reached the centre of the river. The water is being diverted into sluiceways and rows of grouting machines and stone crushers are working at full pace, while trucks come and go. One worker said that the winter here is mild, so there'll be no need to stop work. Geologist Yang Yong said the activity represents the start of a new age: "Hydropower development on the Yarlung has begun, marking the start of a hydropower era for Tibet's rivers."

A series of hydropower stations is proposed for the Yarlung Zangbo. If they are all built, Zangmu will be the fourth in a row of five on the Sangri to Gyaca stretch of the river, between the Gyaca and Jiexu plants. There has been no official confirmation that the construction of these will go ahead. But Yan Zhiyong, general manager of China Hydropower Engineering Consulting, said in a recent media interview: "By about 2020 most of China's hydropower projects outside of Tibet will have been completed, and the industry's focus will shift to the Jinsha, Lancang, the upper reaches of the Nu River and the Yarlung."

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Several well-known Chinese hydropower firms have already made their way into Tibet. The backer of the Zangmu project, the Tibet Generating Company, has already built a residential area on the open spaces alongside the river at Zangmu and a flourishing town is taking shape, with a supermarket better-stocked than those in the county's main town. The boss, from Zhejiang, moved here from the Xiaowan dam in Yunnan, south-west China, two months ago and is positive about the future: "There'll be loads of workers next year, business will be great."

The Zangmu dam is located in the southern Tibetan county of Gyaca, which has a population of around 17,000. "The economy here is going to be among the fastest-growing in Tibet," said businessman Li

Hua, who has already invested in a three-star hotel here – a five-storey building that is now the tallest in the area.

Work on a highway to the administrative centre of Lhoka prefecture is to start in 2011, cutting travel time in half. "Hydropower development will very quickly spur mining, and there'll also be very rapid growth in road and railways. The Tibetan hinterland will see a new development boom," predicted Yang Yong.

Guan Zhihua is a researcher at the Chinese Academy of Sciences' Institute of Geographic Sciences and Natural Resources Research. In 1972 the academy established a survey team to study the Qinghai-Tibetan Plateau, and Guan – now in his seventies – was the head of the group charged with calculating the hydropower potential of the Yarlung Zangbo, China's highest river. As if describing a family heirloom, he said: "The river flows for 2,057 kilometres within China's borders, and its hydropower potential is second only to the Yangtze. It has more power-generating potential per unit of length than any other river in China."

Guan's was the first comprehensive and systematic study of the plateau – a four year field project carried out by more than 400 people across 50 different disciplines. But the study of the Yarlung Zangbo and its tributaries was only a part of the survey, and at the time nobody had any idea of the extent of the river's potential. The entire basin was found to have hydropower potential of 114 gigawatts – 79 of which was on the main river. And this potential was highly concentrated, with the possibility of a 38-gigawatt hydropower facility at the Great Bend in Medog county, equal in power to the Three Gorges Dam.

In 1980, a nationwide survey of hydropower resources was carried out and 12 possible dam locations identified on the Yarlung Zangbo. "This would have been the first hydropower plan for the Yarlung," recalled Guan.

In the 1980s, Tibet twice planned to dam the Yarlung Zangbo, but in neither case did the project get off the ground

Zhang Jinling, a 76-year old retiree from the Tibet Surveying Institute, recalled the first bid to build a dam here: "In the 1980s, Shigatse [a city in southern Tibet] wanted to build a hydropower station at Jiangdang and that would have been the first attempt to dam the river." But there were concerns: this part of the river carries a lot of silt and the project would have required swaths of land to be inundated and many people to be relocated – and the dam would only generate 50 megawatts of power. The plan was submitted to Beijing, but was not approved.

On another occasion, plans were drawn up to dam the river outside Lhasa. Zhang's team carried out preliminary surveys, drilling rock samples out of the mountainsides to acquire geological data. But a large reshuffle of officials in both 1981 and 1982 saw the team lose two-thirds of its manpower. Plans were shelved.

Those plans were spurred by a shortage of electricity in Tibet. Zhang recalled that the Tibetan government was seeking a quick way of providing power by any means – diesel-fired and geothermal power generation were also used.

During the 1980s, Lhasa, with 120,000 residents, only had 20 or 30 megawatts of power-generating capacity, mostly provided by several hydropower stations each providing a few megawatts. In winter there was no choice but to rotate power supplies to different areas of the city, with those cut off using kerosene for heating.

When Zhang retired in 1995, the electricity grid in eastern Tibet was just beginning to take shape, but it has remained isolated from the national grid. A connection between Tibet and Qinghai is due to be completed in 2012, which will relieve the electricity shortages Tibet suffers in winter and spring.

"It wouldn't have been possible to build a large dam on the Yarlung before the Qinghai-Tibet railway was completed – you need a rail line to move the building materials," said He Xiwu, who was head of the survey team's water-resources group at the time.

In 1994, work started on the Three Gorges Dam, but plans for the Yarlung Zangbo were kept quiet. The low-key approach was unusual given the river's huge potential. Even recently, a water-resources official with the Tibetan government stressed that developing hydropower in Tibet was mostly about self-sufficiency.

Since the early 1990s, Tibet has built a series of medium-sized hydropower stations, of about 10 megawatts each, such as the pumped-storage hydropower station at Yamdrok Lake and the dam at Zhikong. These are intended to relieve electricity shortages in the Lhasa area.

Although government work reports mention it every year, hydropower development on the Yarlung Zangbo was never made a priority. But in the final years of the 11th Five Year Plan, things changed. "The current proposal is an appropriate degree of industrialisation, with a process of capacity building, then focusing on priorities, and then overall development," said He Gang, research fellow at the Tibet Academy of Social Sciences' Institute of Economic Strategy. "The priorities most often proposed are mining and hydropower."

Behind the scenes, preparations for hydropower development on the Yarlung Zangbo have been constant. In a recent media interview, Zhi Xiaoqian, head of the Chengdu Surveying Institute, said that plans had been drawn up for all of Tibet's major rivers, including the middle reaches of the Yarlung Zangbo. But a lack of clear policy direction has meant approval for those plans has been slow and the projects have not commenced. "Now the time and conditions are ripe. China's energy supply is becoming ever more pressured, and there's an urgent need to develop the rich hydropower resources of Tibet," Zhi said.

Currently less than 0.6% of Tibet's hydropower resources have been developed. In comparison with the rest of China, this is virgin territory.

The Zangmu Hydropower Station is only the start. The huge potential of the Yarlung Zangbo is concentrated at the Great Bend in Medog county, where two or more dams the size of the Three Gorges could be built. This is also the most spectacular section of the river, where it falls steeply as it makes a u-turn, and is regarded as one of the world's most striking river sections.

As early as 1998, Chen Chuanyou of the Institute of Geographic Sciences and Natural Resources Research at the Chinese Academy of Sciences published an article in Guangming Daily entitled "Could the world's biggest hydropower station be built in Tibet?" He proposed building a reservoir on the middle reaches of the Yarlung Zangbo to raise the water level, and then drilling a 16-kilometre tunnel to carry the water to its tributary, the Duoxiong – a drop of 2,300 metres that would allow for three hydropower stations. For the sake of safety and the environment, they could be built underground, he said.

In 2002, Chen published another paper in Engineering Sciences, looking at the positive impact that a hydropower station at the Great Bend would have on electricity generation in south-east Asia, and pointing out that, if there were financial issues, funds could be raised both domestically and abroad, and that electricity could be exported to south-east Asia.

He Xiwu said: "I've heard there is still no plan for the Great Bend. The state should spend a bit every year on long-term research. There's 38-gigawatts of potential there, but the geology is complicated and construction would be difficult. It has to be done carefully."

"Hydropower development in Tibet has come late, but it is on the agenda now," said Fan Xiao, chief engineer for the regional geological survey team at the Sichuan Bureau of Geological Exploration. What worries

Fan, however, is this: "Tibet's ecology is extremely vulnerable, and would be very hard to restore if damaged. This kind of full-river development can't just see the Yarlung Zangbo as a hydropower resource – everything needs to be taken into consideration."

This article was first published by Southern Weekend.

He Haining is a reporter and Jiang Yannan an intern at Southern Weekend. Feng Jie, also a reporter, contributed to this article.

Image by Fighting Irish 1977

September 05, 2011

Tibet's mining menace

The Tibetan Plateau holds the key to China's accelerating demand for heavy metals, say authorities. But this plan is driven by resource nationalism rather than market logic, argues Gabriel Lafitte.

China's fast growth continues, largely financed by state investment and, until very recently, cheap finance from state-owned banks. Fast growth and massive infrastructure construction require heavy usage of metals, energy and raw materials. Although the two latest Five-Year Plans talk about balancing environmental protection with social needs, as well as the fastest possible growth rate, nothing so far has slowed China's accelerating consumption of global resources.

Few in China see anything problematic here: China is simply catching up with the rest of the world, and on a per capita basis, its metal consumption is still far behind the richest countries. That may not, however, be true for much longer. Take copper. Not only is China by far the world's biggest producer of copper, consumption per person is already higher than in Canada, France or Russia and will soon overtake Australia, the European Union and Japan. This is not surprising when one looks at where copper is used: to produce the growing number of cars, household appliances and power cables consumed by the increasingly wealthy Chinese market.

China has also emerged as the world's second biggest consumer of gold, surpassed only by India, where gold jewellery has long been culturally embedded. With the enthusiasm for gold as an investment as well as for its industrial uses, the World Gold Council confidently expects consumption in China to double within a decade.

But where will the copper and gold come from for all those cars and cables transmitting ultra high voltage electricity across China? Ironically, these heavy metals and the electricity are to come from Tibet.

Both copper and gold are booming and new mines are coming on stream around the world, as prices dipped only briefly during major financial crises, and then rose to even greater heights. This has not been a problem for China's metals manufacturers, which have ridden the boom. The coastal location of most smelters and their manufacturing customers has helped, giving them ready access to global supplies.

> *Gyama mine is already operational and, located just upstream of Lhasa, poses a threat to the purity of the water in Tibet's most sacred city.*

All this is now changing. Global sourcing of raw materials for coastal industries is shifting to domestic sourcing far inland. Manufacturing is moving inwards, encouraged by central policies to soften the extreme inequality between the east coast and the interior. In western China, the new Chongqing-Chengdu industrial hub is fast emerging, preparing itself to export to the world via the Yangtze. It is now as if the coast of China extends 2,000 kilometres inland.

But the Volvo cars made in Chongqing, the Ford cars made in Chengdu, the Hewlett-Packard, Apple iPad and Lenovo computer factories in these two

cities, will all need plenty of metals. And the solution, according to central planners, is to tap into sources of copper and gold more remote than China's current mines in Zambia, Peru, Mongolia, Laos, South Africa and Kazakhstan. The answer to China's accelerating demand for copper and gold is the Tibetan Plateau.

China has long known of the mineral wealth of the Tibetan Plateau but until now it has been easier and cheaper to buy minerals overseas. Tibet has been too remote, too cold, the air too thin and the infrastructure absent. Small-scale extraction of surface gold from riverbeds has been frequent, and environmentally destructive, with much use of dredges, cyanide and mercury that kill aquatic life and poison streams; but large scale exploitation is new. Publicly, small-scale mining is now banned, but in practice it persists, especially in districts where there are no longer Tibetans on their lands to protect it, having been removed in the name of watershed protection.

Now a new era is under way. The state has paid for the necessary infrastructure of roads, railways, power stations and urban facilities. State geological exploration teams have spent decades mapping known deposits, preparing sites for full-scale extraction. Tibet Autonomous Region (TAR) chairman Pema Choling, reporting on the achievements of 2010, said: "With the focus on opening up to the country's hinterland region, we have actively merged with the Chengdu-Chongqing economic sphere."

The biggest copper and gold deposits in Tibet, from west to east, are in Shetongmon, Gyama and Yulong districts, where central planners say there will be many mines, ore crushers, chemical concentrators and smelters. Large-scale industrial mining has arrived. These mines contain silver, lead and zinc as well as copper and gold, although the lead and zinc will go to waste. And all these mines are situated in the watersheds of Asia's major rivers that support hundreds of millions of people downstream.

Shetongmon mine was the first major project to attract publicity, partly because of its sensitive location so close to the Yarlung Zangbo and Shigatse city, the historic seat of the Panchen Lamas; and partly because it was for some time owned by Canadian investors. By the time the railway to nearby Shigatse is completed in 2014, the mine will be operational.

Its proximity to a major river raises serious environmental concerns, since the steep site will have to securely hold at least 75 out of every 100 tonnes of rock mined and crushed to powder to extract a concentrate that can be sent by rail to a distant smelter. According to recent research by Tibetan scientists, there is already a natural heavy-metal load in the river; any leakage from the hillside dam waste tailings could be disastrous. Not only would downstream India and Bangladesh be affected; if the planned water diversion of Tibetan rivers to the Yellow River includes capturing the Yarlung Zangbo, downstream China's water purity would be threatened too.

Gyama mine, controlled by Vancouver-based China Gold, is already operational and, located just upstream of Lhasa, poses a threat to the purity of the water in Tibet's most sacred city. Like most of Tibet, the area is seismically unstable, vulnerable to earthquakes. A study of water quality below the Gyama mine carried out in 2010 revealed that "elevated concentrations of heavy metals in the surface water and streambed at the upper/middle part of the valley pose a considerably high risk to the local environment… and to downstream water users. Environmental changes such as global warming or increased mining activity may increase the mobility of these pools of heavy metals."

Local Tibetans have protested and sent a petition to Chinese authorities demanding the closure of the mine. The mining operation has reportedly dried up spring waters, poisoned drinking water, killed 1,000 domestic animals and destroyed flora and fauna in the region. Despite this, in August 2011, China Gold announced that it had boosted the resources of the

mine by over 400% and will proceed with a major expansion of the project.

The Gyama mine has already operated for many years on a smaller scale, under various owners who lacked capital to invest in sufficient health and safety practices. Of particular concern for human health, especially for the growing brains of the children of Lhasa, is the lead content of the Gyama deposit, which will not be recovered, and so lie forever in waste dumps below the mine.

But this is the first highly profitable project in Tibet, both for the mining company, which will have sales of 45.6 billion yuan (US$7.2 billion) over the mine's life, and for China's central government, which will earn 4.9 billion yuan (US$767 million) in revenue from taxes. These figures are based on 2010 copper and gold prices. If mid-2011 prices are used, profit will be a lot higher.

The Gyama deposit contains less than one million tonnes of copper metal, but nearby, also upriver from Lhasa, is Chulong, a much bigger copper deposit (seven million tonnes) and commercially attractive molybdenum metal as well. The recently discovered Chulong deposit is in a mountain chain that drains northwards to the great Ganden monastery and southwards to Samye, location of the first Buddhist monastery built, over 12 centuries ago, and thus deeply venerated. Heavy metals escaping from Chulong to air and water would be an even greater threat to all these places in one of the most densely populated parts of Tibet.

Yulong is one of a cluster of copper and gold deposits in eastern Tibet, in a remote and rugged area between the watersheds of the Yangtze and Mekong rivers. Electricity sufficient to power a smelter will be supplied by hydropower dams that central planners have announced will be built on these great rivers and their major tributaries, causing massive interruptions to wild mountain rivers.

These mines are planned to add hundreds of thousands of tonnes of copper each year to China's supply, which is both a lot and not very much. For Tibet it is a lot, signifying nothing less than the remote region's integration into the Chinese industrial economy. It is also a lot for Tibetans who, even after the mines are exhausted and closed, will have to bear the environmental costs, but are not permitted to establish NGOs to give voice to environmental concerns. Nor will Tibetan communities receive royalties from these projects.

Yet these mines will do little to reduce China's reliance on global sources for raw materials. China's copper-smelting capacity is just over four million tonnes a year, with a further 600,000 tonnes due to begin production soon. But China's copper consumption is now seven million tonnes a year. The difference is made up by imports. Even if the new mines meet production targets, despite several recent delays, China's imports of copper and gold will continue to rise.

Although Chinese state-owned mining companies are now adept at operating and raising capital globally, they are also good at drumming up resource nationalism. The reality is that the Tibetan deposits being turned into mines are hardly world scale. The biggest copper deposits in the world hold over 100 million tonnes of actual copper each; and have the capacity to produce, on average, a 345,000 tonnes of metal a year, and none produce less than 200,000 tonnes. Even the biggest deposit in Tibet, Yulong, is only a small fraction of the size of the largest mined deposits worldwide. It currently produces 10,000 tonnes of copper a year, but according to officials this might reach 100,000 tonnes by 2015. But these deposits are currently the biggest in China, a fact strongly emphasised by their corporate owners, keen to elicit state subsidies.

While patriotic Chinese netizens might presume it is better to source copper from Tibet than Peru or Zambia, China's mining companies would seldom invest abroad in copper deposits of only a few million tonnes, especially if bigger deposits are on

the market. So why are remote Tibetan mines going ahead, if they cannot be justified on market economy grounds? Commercial considerations are only part of the picture.

The mining companies benefit from state financing of railways, power stations and much other infrastructure, as well as receiving finance at concessional rates to corporate borrowers, tax holidays, minimal environmental standards and costs, no royalty payments to local communities and subsidised rail freight rates to get concentrates to smelters or metal to markets. It is these state subsidies that tip the balance towards medium-scale mines in several Tibetan locations, rather than one more big Chinese copper mine overseas.

The Shetongmon mine was originally scheduled to begin production in 2010, but the operational date has been put back to when a rail line connecting via Lhasa to inland Chinese smelters and markets can be completed. The same is true of the Gyama mine, which is on the route of another new rail line from Lhasa to Nyingtri in southern Tibet. And the Yulong mine has been slow to develop beyond a modest scale, while awaiting the completion, at state expense, of hydropower dams and a rail line, still some years away.

A further reason for delay is the difficulty – given the steep terrain draining both the Yangtze and Mekong – of guaranteeing no leakage of toxic metals into rivers. The Qinghai-based Western Mining and Zijin, China's biggest gold producer, own Yulong mine. In early 2011, Zijin was found guilty of a toxic spill in Fujian province that poisoned fish and polluted the drinking water of tens of thousands of people last year. In March 2011 Xinhua reported that "after a short period of trial operation, the Yulong project was suspended due to environmental issues. It is unclear when the project will be continued." However, Zijin is too influential a company for the project to be long delayed.

China's 12th Five-Year Plan says Tibet will become a "non-ferrous metals base" for inland heavy manufacturing concentrated in Chongqing and Chengdu. If this is to happen, it will not be driven by market economy logic, but by a nation-building agenda subsidised by the centre.

Gabriel Lafitte is an environmental policy consultant who has worked with Tibetans for over 30 years.

Image by Preston Rhea

Part 7: Downstream in south-east Asia

The major rivers of south-east Asia – the Mekong, Irrawaddy and the Salween – all originate on the Tibetan Plateau. Dam building on the upper reaches of the Mekong in China has sparked popular outrage. Similarly, mega projects planned on the Mekong in Laos and on the Irrawaddy in Myanmar downstream have provoked similar fury.

This section presents a few highlights from our coverage of the growing challenges facing south-east Asian rivers. Historian Qin Hui argues that China's lack of openness in relation to river management is attracting unnecessary suspicion. Philip Hirsch writes that China has triggered a revival in hydropower ambitions downstream. And Yang Meng describes how China's state-owned energy firms have entwined themselves in Myanmar's internal struggles.

Downstream in south-east Asia
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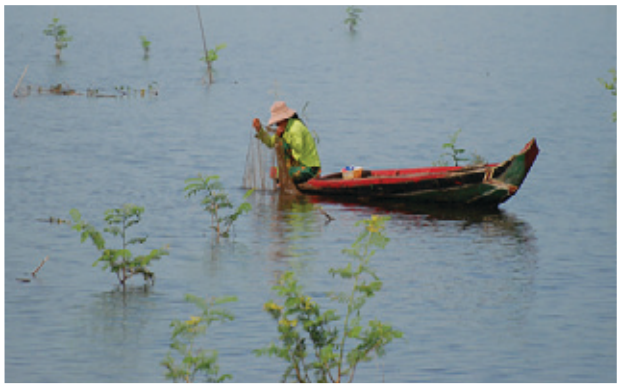
December 30, 2010

On the Mekong, a better way

Dam-building in south-west China has provoked fury downstream. Historian Qin Hui criticises Beijing's response.



The Cambodian prime minister is in China's good books. In a recent – and friendly – speech, Hun Sen said that this year's record low water levels on the Mekong River have been caused by irregular rainfall triggered by climate change and that linking it to the construction of Chinese hydropower dams is misguided.

On November 18, when reporters asked China's Ministry of Foreign Affairs spokesperson Hong Lei what he thought of Hun Sen's remarks, he said: "China and downstream countries are good neighbours and our development in water resources exploitation on the Lancang-Mekong River is fully consistent with the interests of those countries along the Mekong River. As a responsible upstream country, China has always attached great importance to environmental and ecological protection during the development of water resources on Lancang River and fully considered the concerns of downstream countries."

Two days later, however, the Washington Post published an article saying experts are predicting China's dam construction on the Mekong will devastate the lives of millions of people who rely on eating fish from Cambodia's inland lake, Tonlé Sap – something Cambodia has not criticised Beijing over. The article says: "The perennial question about China's rise is: when will Beijing be able to translate its cash into power. In Cambodia, it already has."

Whatever the Cambodian president says, international concerns about China's dam-building activities on transboundary rivers have clearly not gone away. And Chinese scholars continue to debate the issue. Here, in an in-depth, three-part essay, professor Qin Hui of Tsinghua University offers his views.

China's hydropower development on the Lancang River (known as the Mekong once it leaves China's borders) has prompted criticism from countries downstream in south-east Asia. In particular, extremely low water levels seen on stretches of the river during this year's drought in south-west China, triggered intense media scrutiny in countries including Thailand and Laos.

> *"It is impossible for a large reservoir to have 'no impact' downstream. The right question is: what kind of impact?"*

Speaking at a press conference in March, an official from China's Thai embassy responded to the outcry by repeating the usual refrain that "outflow from China into the Mekong only accounts for 13.5% of the volume at the river mouth". He pointed out that the surface area of the reservoirs behind China's three dams on the river – at Manwan, Dachaoshan andJinghong – is very small and results in negligible evaporation, while hydropower generation does not actually consume any water and therefore has virtually no impact on the river. And so on.

On a recent research trip to south-east Asia, I heard frequent complaints that China's hydropower development is causing all sorts of environmental

problems downstream. There was no – or at least not enough – evidence for many of these claims, a point I constantly put forward. But I still find China's official response inappropriate, not to mention ineffective atclarifying the true situation. In fact, this stance could easily be used against China, as it gives the impression the country is trying to pull the wool over the eyes of its critics – particularly given that the statement made in Thailand was written not by the embassy, but by China's hydropower authorities.

First, let's deal with the claim that outflow from China accounts for only 13.5% (some say 14% or 16%) of the Mekong's flow when it reaches the sea. This has been a catchphrase for Chinese officials in the past few years and has some validity in relation to problems occurring far downstream, particularly near the river's mouth. Vietnam's complaints about seawater intrusion in the Mekong Delta are one example. The bulk of the water in that part of the river does not come from China and so we can legitimatelyargue there is no reason to point the finger in that direction.

However, for most of the length of the river outside of China's borders, outflow from China accounts for a much larger proportion of overall volume. For example, at Luang Prabgang in Laos, on average two thirds of the river water has come from China. So we cannot claim that the problems in these places have nothing to do with China. The floods around the Laos capital of Vientiane in 2008 and the historically low water levels seen in certain areas this year all occurred on stretches of the river where most of the water comes from China. In these cases, there is no sense in pointing out that China accounts for only a small proportion of the flow at the river mouth.

Drought was of course a contributing factor to this year's low water levels, but with so many huge dams on the river China needs to back up its claims that the changes in flow were entirely natural. Talk of small surface areas, low evaporation and hydropower not consuming water are transparent attempts to fob off China's critics. The impact of a reservoir downstream has nothing to do with "water consumption" or "evaporation", but the impoundment and release of water. Opening or closing floodgates has a huge impact on downstream flow. Otherwise, how could we talk about reservoirs preventing floods and relieving drought?

Of course, the impact is limited to the capacity of the reservoir. And so we talk of dams being able to regulate downstream flow on a daily, monthly, seasonal, annual or multi-year basis. But China has a huge capacity to do this. Yes, only some 14% of the water at the Mekong's mouth comes from China. But 70% of reservoir capacity in the Mekong Basin is within China – and this will rise to 90% when the Nuozhadu dam (a nine generator scheme under construction in Yunnan) comes into operation. Moreover, all of China's Mekong reservoir capacity is on the river proper, while other nations have built dams only on tributaries.

Our officials describe the Manwan, Dachaoshan and Jinghong reservoirs as being "of small surface area". But a reservoir's effects depend on its volume. Why talk about the area? These three dams are all over 100 metres high, with reservoir capacities of 920 million, 940 million and 1.4 billion cubic metres respectively: in total, the equivalent of three Dianchilakes.

The Manwan and Dachaoshan dams are said to be able to regulate river flow on a seasonal basis, while Jinghong can do so on a monthly (some sources say seasonal) basis. So at the very least, they can influence seasonal river flow downstream. We can argue about whether that is a positive or negative influence, but to disregard common sense and claim these reservoirs have no impact – and then to muddy the issue with talk of "evaporation" – simply makes China look bad.

Particularly bizarre is the fact that China's officials for some reason talk of the "three reservoirs of the Lancang", when domestic media have reported on a much bigger fourth project: the Xiaowan dam. Electricity generation here started in September 2009 and, at a height of 300 metres, it is the world's

highest arch dam. Its power-generating capacity is claimed to be second only to the Three Gorges dam, while reservoir capacity is variously said to be 15.3 or 14.6 billion cubic metres – almost five times the total capacity of the other three reservoirs.

If all the water flowing into the reservoir was impounded – cutting off the river completely – it would still take four and a half months to fill it from empty. And then if a dry period saw river levels fall to half of normal, the release of water could restore normal flow for a full 10 months. You could call that quite a substantial "impact".

According to the hydropower industry, Xiaowan has the ability to regulate river flow on a multi-year basis and is a "tap" that can ensure hydropower stations downstream – including at Jinghong near the border – enjoy a steady flow of water through both the wet and dry seasons. And yet China's officials speak of "virtually no impact". Nations downstream suspect the Xiaowan reservoir is still being filled, since it is so big and the dam only started working in September, 2009. Even a severe drought like the one this year could be exacerbated by a huge reservoir being filled upstream. To determine whether or not this did happen, we must look at how the reservoir was actually operated. Simply claiming there is no impact at all will fool no one.

Furthermore, we know that work started on an even bigger reservoir – at Nuozhadu – in 2006 and that the river has already been dammed. With a capacity of 23.7 billion cubic metres, this scheme will also be able to regulate river flow over a number of years. Not only is it bigger than Xiaowan, but it is also nearer the border. Once that reservoir starts filling, will China again claim it has a small surface area, doesn't evaporate much, consumes no water – and has "no impact"?

The inevitable conflict

It is impossible for a large reservoir to have "no impact" downstream. The right question is: what kind of impact? It can be positive or negative, depending on how the reservoir is built and – more importantly – how it is operated. There are myriad ways to run a reservoir but, simply speaking, there are two basic methods:

One is to manage the reservoir with the aim of preventing floods and relieving drought – in other words, positive regulation. Usually this means emptying out the reservoir until flood season and then storing as much water as possible to lower flood peaks downstream, bringing the reservoir to capacity just as the season ends.

During the dry season, natural flow is passed through and supplemented with water from the reservoir to increase downstream flow, bringing water levels behind the dam to their lowest point by the time the next flood season starts. This relieves both floods and dry periods, evening flow out between the two seasons, and is normally welcomed downstream. But it conflicts with the demands of electricity generation and the need to prevent silt accumulation in the reservoir.

The second method of reservoir operation is almost the direct opposite: store clean water and let silt-laden water flow out. Flood waters carry higher levels of silt than regular flow and this settles on the reservoir floor when the water is impounded. To prevent a build up of sediment and maintain reservoir capacity, it makes more sense to allow flood waters to pass through the dam and instead to store water during the dry season, when there is less silt. And as electricity generation depends on the flow and the head – the height of the water in the reservoir relative to the height the water level on the other side of the dam – storing what little water there is during dry season makes sense as it helps keep the reservoir high.

However, this is exactly what downstream neighbours want to avoid and, if carried through fully, exacerbates both flooding and drought. Both the Three Gorges Dam and Samnmenxia dams use this

method to varying degrees and have presented it as a great innovation. In reality, it is an obvious way of boosting power generation and maintaining capacity but is completely at odds with the original aim of preventing floods and relieving drought. Severe sedimentation – particularly at Sanmenxia – made it necessary. Although experts did their best to come up with sophisticated ways of regulating flow by way of a compromise, the reservoirs' ability to function as intended has been greatly reduced and, at Sanmenxia, is as good as abandoned.

So the interests of the dam operators (maintaining capacity and generating power) and those of downstream residents (preventing floods and relieving droughts) often conflict. Given this, it is understandable if those operating the dams on the Lancang and populations downstream express differing needs.

A Thai official was quoted in the Chinese press as saying – in response to criticism of China in his country – that, since Chinese dams do not impound water during the dry season, the unusually low river levels were insteadcaused by a drought brought about by global warming.

This official presumably had not heard the theory that Chinese dams do exactly this. Whether or not these reservoirs are storing water in the dry season needs to be clarified by China's own authorities. Some say China has actually been doing the opposite – releasing water to relieve drought. And, equally, if that is the case Beijing should make it known. But instead, the country's officials talk solely of "no impact" and "evaporation".

Attracting unnecessary suspicion

If it became clear that China has indeed been impounding water during the dry season, then a wave of criticism would likely follow. But there might also be gratitude: while people living downstream of a reservoir normally hope it will prevent flooding and relieve droughts, in certain circumstances they actually desire the opposite.

Evaluating the impact of a reservoir is complicated. Not only are there various ways of operating a dam, but one particular scheme can also have different consequences for different stretches of the river. China and downstream nations may have competing interests, but there are also conflicts of interest between the downstream nations themselves.

> *Anyone benefitting from upstream schemes will see no need to thank China, while those suffering simply reject its claims, since it has provided no proof.*

For example, the 2008 floods on the Vientiane plains in Laos and the drought on the northern Mekong have both resulted in complaints that China's reservoirs are making the changes in river level more extreme – flood peaks are higher and dry periods drier.

But in Cambodia I heard a different story. There, the Tonlé Sap Lake relies on seasonal changes in the level of the Mekong. In flood season, water flows back up a tributary to fill the lake which, in turn, rises to cover a much greater area. The floods carry nutrient-rich sediment, providing nourishment for the unique strain of high-stalked rice that grows there, and the higher waters allow fish populations to migrate upstream and breed (this is one of the world's largest freshwater fisheries). In the dry season, the water flows back out into the Mekong, the lake shrinks and the locals get out of their boats to collect the fish stranded in traps and harvest the now mature rice And so the lake is known as the land of rice and fish.

This semi-aquatic traditional way of life and the unique seasonal ecosystem both rely on the rise and fall of the Mekong. Unlike those living on the banks

of the river in Laos, the people here worry that the flood waters won't come or that the river will remain in full flow during the dry season. Here, they complain that the changes in the level of the Mekong have been too small – the lake doesn't rise enough, meaning the water doesn't reach all of the rice, while in the dry season water levels are too high and much of the rice harvest is lost.

Add in the impact on fish migration, and the land of rice and fish isn't as abundant as it used to be. Locals are earning less and both the way of life and the ecosystem are under threat. Some point the finger at China's reservoirs, blaming the impoundment of flood waters and the release of water during the dry season.

I explained to the people I met that I had no idea what China's reservoirs were actually doing and therefore didn't know if they could be blamed or not. But I could be sure that these complaints contradicted the ones I had heard in Laos: either of the charges could be true, but not both at once.

If China is responsible for the problems in Thailand and Laos, then we need to look at changes in rainfall patterns and the flow of tributaries such as the Kong River and Tonlé Sap itself to explain the woes at the lake: they cannot have anything to do with China. It could also be possible that both sets of problems are driven by local changes and that China's reservoirs are innocent on both counts. But a firm conclusion requires an examination of the region's hydrology and data on the operation of China's reservoirs.

Only abuse

This brings us to a deeper issue. If it were true that China's reservoirs weremaking changes in water level more or less extreme, in either case there would be advantages and disadvantages. And, by rights, China should – in amongst the complaints – be hearing words of gratitude. If Laos and Thailand are complaining about more extreme changes, Cambodia should be thanking China. And vice versa. But there are only complaints. Is this simply anti-China bias at work?

In fact, I believe the problem stems from claims in certain Chinese quarters that the country has "no impact" downstream. This means that anyone benefitting from upstream schemes will see no need to thank China, while those suffering simply reject its claims, since it has provided no proof. Is there evidence for their complaints? No – because China has not published data on what is actually happening at the reservoirs, making it impossible to objectively evaluate that "impact". And if "evaporation" is then brought up, they may simply conclude they are being lied to.

For example, everyone knows that natural drought has played a role in the drying up of the Mekong. But how did China's reservoirs respond? The authorities refuse to say. Maybe the country deserves thanks for releasing water (even if the drought was so severe that this action didn't help). And ifit was impounding water, well then it can hardly refute the complaints. But refusing to say one way or the other means that China is either losing out on the thanks it deserves from Cambodia, or failing to provide the evidence necessary to counter complaints from Thailand and Laos.

The evasiveness of the authorities over reservoir operation means that, if China is doing something good, nobody knows about it. But it cannot hide any harm that it does and will be suspected of causing harm it has nothing to do with. What sort of strategy is that?

Furthermore, some parties appear to think that other nations work like China – that the entire country will stick to the official line and so you only need to worry about the official stance. I once heard an employee of a Chinese-funded firm complain: "Their government isn't saying anything, what are the NGOs and media doing going on about it?" But these countries work differently – public opinion and official statements play complementary roles, with the public saying

what the government is not able to say in order to apply pressure and leave the authorities room to manoeuvre.

But in China, we argue that diplomacy is too important to be left open to public debate and keep a lid on comment. If this means China cannot use public opinion to strengthen its voice internationally, so be it. But if the country applies this view overseas, believing that all it needs to do is win over government officials while public opinion can be ignored or fobbed off, the results will be poor. Western diplomacy often takes a tough line with foreign governments but is softer with public opinion. In China, we used to joke that our officials were scared of foreigners, while the foreigners were scared of us. Maybe we should remember this when we are the foreigners.

Opportunity in friction

As well as plenty of finger-pointing, this year has seen positive developments in the regional conversation over the Mekong. In the run-up to the April meeting of the Mekong River Commission, a collaborative body founded by Vietnam, Laos, Cambodia and Thailand, and at which China and Burma have observer status, China made a welcome gesture of cooperation. It said it would: provide hydrology data from the Manwan and Jinghong reservoirs; consider downstream interests when planning development of the river;and be willing to discuss matters with those affected by such development.

These are all good signs, but I still think China could be more open. For example, why is it handing over data on only the two smaller reservoirs and not the key Xiaowan reservoir, which is 10 times bigger and able to affect river flow over a number of years? It would at least be consistent if China – on grounds of sovereignty – refused to provide any data at all (not, of course, that I'm suggesting it do that). But to provide data on only the smaller reservoirs will only make others wonder what is going on elsewhere. And if further criticism forces China to provide the extra information, then it will appear to be on the back foot.

Could China not be more proactive? After all, the reservoir does not have a lid and there are any number of satellites that could monitor its water levels. And if, as some have speculated, China's critics have "received support from western, anti-China forces", it would be a small step for the west to hand over that datato countries on the Mekong. If they aren't receiving that data, then the speculation is unfounded. Why doesn't China just hand it over and avoid unnecessary suspicion?

On my visits to south-east Asia, I encountered misunderstandings about China's actions among the general public. For example, I heard complaints about this or that consequence of the "eight reservoirs" China has built on the Lancang – even though the country has so far only constructed four of the eight it eventually plans to develop.

However, most of the complaints I heard focused not on what China is doing, but on its refusal to communicate, which leaves these communities in the dark. They say China's authorities are only willing to deal with governments, and not NGOs or the public, and that attempts to obtain information from Chinese embassies and companies are rebuffed. Western nations do better in this respect: many western companies operating in the region actively invite NGOs and the media to visit their construction sites and ask questions. Contacts in Chinese firms tell me western firms are good at winning over those NGOs and media organisations.

One person specifically mentioned two dams located near to each other in Laos. The Chinese-built dam is guarded by the military, and no visitors are allowed. The western-built dam, meanwhile, is open to NGOs and the media and has a constant stream of visitors. He might have sneered at the western method, but you can imagine which the local people prefer.

The Mekong River Commission is an important channel for official contacts, and with support from the United Nations and other international actors, it is highly influential. But when the body was founded in the 1990s, relations between China and many of the participants had not yet normalised, and so China was not invited to participate. This is of course not the country's fault, but now that friendly relations are in place and China's development of the river – and the impact downstream – is intensifying, there are hopes that China will take part. The range of competing interests within the body leads many in China to believe it is an inefficient talking-shop, however. And, so as to avoid being held back by the commission, China prefers to remain as an observer only.

As this article makes clear, opinions on how the river should be managed differ from place to place. It is not just a case of China versus downstream nations; the downstream nations themselves have many conflicting interests. No matter how China's reservoirs are operated, there will be both advantages and disadvantages downstream. We cannot please everyone. But if China unilaterally decides what to do, it may end up failing to win the gratitude of those it helps, while encountering protest by those who are suffering.

If we had the right principles and mechanisms for coordinating multilateral interests and were able to set up the necessary compensation and responsibility systems, things would be different.

As I have said, the demands of Thailand and Laos are completely different from those of Cambodia – but they only complain about China, and not each other. The reason for this, apart from the lack of ability to control the river themselves, is that as all these nations participate in policymaking at the Mekong River Commission. They have a shared responsibility. Whatever the consequences of that policy, nobody can complain that one country is purposely harming another. But China still bears sole responsibility for its actions, so gets no thanks and only criticism. China's impact on the Mekongis increasing and its participation in a multilateral decision-making mechanism would be of benefit to all involved.

Applying lessons at home

Some foreign observers have blamed the drought in the northern Mekong on China's "hegemony", a criticism I have refuted on many occasions. However hydropower operators are behaving outside of China, you can believe it would be even worse at home. Downstream nations may criticise China for ignoring their interests, but I think the energy firms take overseas complaints more seriously than those made domestically, particularly when those complaints come from governments. Complaints from international civil society – the media, mass organisations and NGOs – may not appear to be treated seriously, but the situation is still better than it is in China.

In China there are often conflicts of interest arising from new reservoirs, relocations and changes in water levels; between flood prevention and drought-relief needs and the interests of the hydropower operators themselves; or between development and the environment. There has been fierce debate over the Sanmenxia dam on the Yellow River and the Pubugou dam in Sichuan, for example: should the dam be built? How should it be built? And once built how should it be run? Answering all of these questions requires different interests to be weighed up. Today it seems it is only environmental groups that can speak out against hydropower. But these issues cannot be summed up simply as "environment versus development", and China still lacks the mechanisms to work through them.

In China today, internal reform and opening up to the outside world are two aspects of the same process. China's participation in globalisation should provide the country with lessons that it can take and apply at home. In the past I have spoken of the lessons Latin America's largest Chinese-backed firm, Hierro Peru, learned about dealing

with independent unions from its experiences with striking workers and the praise Chinalco earned for respecting local land rights at Aurukun in Australia. This knowledge could help Chinese firms at home improve labour rights and reform compulsory land acquisitions.

Similarly, the Mekong controversy could help our hydropower operators learn how to handle relations with other interested parties. I do not believe this dispute is just an international issue, much less that it is appropriate for China simply to adopt a nationalistic stance in dealing with it.

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Image by Paul Mannix

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Cascade effect

By building dams on the upper Mekong, China has triggered a revival in hydropower ambitions downstream, writes Philip Hirsch.

Much has been written on the downstream impact of China's dams on the Mekong River, which flows through or along the borders of Burma, Laos, Cambodia, Vietnam and Thailand after exiting China (where it is known as the Lancang). The discussion largely focuses on the hydrological impact of impounding water in the eight dams along the mainstream upper Mekong River in Yunnan Province. The Mekong Cascade, as it is termed, has caused considerable controversy in downstream countries, most notably during the2008 floods and the 2010 drought, which many blamed on China's actions.

Clearly, the cascade has major implications for downstream hydrology, with the potential to exacerbate or ease both floods and droughts and impact on fisheries and other sources of income. (chinadialogue has published recent articles on the implications of altered river hydrology and China'sneed for better public relations around its schemes). But China's dams also have indirect ramifications, which receive less attention. Most notable of these is a revival of dam aspirations among downstream governments.

There are currently proposals for up to 11 dams on the lower Mekong mainstream, the section of the river below China. Some of these are in areas bordering or inside Laos, Cambodia and Thailand, three of the four countries that are member states of the Mekong River Commission (MRC), an inter-governmental agency formed in 1995. Dams have been planned for the lower Mekong since the 1950s, but the Cold War subsequently put development on hold. By the time mainstream dams came back onto the agenda in the early 1990s, environmental concerns over large dams had grown to the extent that simply dusting off these megaprojects designed a generation earlier was unpalatable and, until recently, it was widely assumed mainstream dams were off the agenda altogether.

Several factors help explain the revival of Mekong mainstream dams, and China is implicated in a number of ways. One way in which China's own development of the river drives the logic of building more dams further downstream is simply the demonstration and equity effect: the Lao government in particular sees no reason why it should hold back on developing a shared river when an upstream country is already doing so.

A more material way in which China's schemes have helped bring the lower mainstream dams back into the decision-making arena is through the changed hydrology of the Mekong River. Particularly in the upper reaches, immediately below the eight-dam cascade, the altered flood hydrology makes the economics of dams on the lower mainstream more favourable than before.

Early versions of the lower mainstream dams included large storages, for example at the giant Pa Mong dam proposed during the 1960s. However, the scaled-down versions are commonly referred to as "run-of-river" dams, dependent on the seasonal flow of the river to generate power without being able to store more than a few days flow at most. With a more even flow from the upper Mekong dams,

with more water available during the dry season and less during the wet season, the prospects for year-round power generation are greater than under an unregulated monsoonal flood regime.

Another role that China is playing in downstream development is as investor. Chinese state-owned power corporations have stakes in several of the key projects. Until the 1990s, most dams in the lower Mekong countries were public investments, based on loans from the World Bank and Asian Development Bank. The game has changed, however, and most dams are now commercial projects. China has weighed in heavily here: it is estimated that up to 40% of the proposed tributary and mainstream hydropower development in coming years in MRC member countries – in other words, outside China – will be done by Chinese companies. These projects include four of the eleven proposed mainstream dams, at Pak Beng, Pak Lay and Xanakham in Laos and at Sambor in Cambodia.

Recent concern within Beijing's foreign-policy machine over the country's image abroad has led to some interesting changes in the way the nation conducts its hydro-business. At the MRC summit in Hua Hin in April last year, China agreed to release more data on inflows and outflows from its cascade of dams on the Mekong River. This came in the wake of disquiet over the possible impacts of reservoir filling and releases on low flows and flash floods. While China's data-sharing still falls far short of full disclosure, the move did reveal awareness of the need to cooperate with downstream countries.

Sino-Hydro and other companies have also been taking environmental-impact assessments more seriously than in the past. Sino-Hydro's Nam Ngum 5 tributary dam is being used as a test case in a new hydropower sustainability assessment protocol that has been developed by the international hydropower industry in dialogue with some NGOs and other partners.

Another knock-on effect of China's role as the upstream player in the Mekong is a shift in local geopolitics, driven by the re-entry of the United States into the region through its Lower Mekong Initiative. While the US has yet to decide what material developments will take place under this programme, the announcement of the initiative has included thinly-veiled attempts to trump Chinese influence in the region, sometimes portraying the United States as a downstream friend to counterbalance the upstream environmental foe.

What do these seemingly disparate, indirect aspects of China's role in Mekong mainstream hydropower beyond the Mekong Cascade tell us about the region's environmental politics and development trajectories? There are at least two ways in which they paint a more coherent picture than is immediately apparent.

First, it is useful to understand the political logic of the mainstream dams in China and the lower Mekong in terms of path dependency, or the idea that events and their consequences are triggered and explicable in part by previous events and can go on to influence yet further developments. That is, while the immediate considerations of the Mekong Cascade have been considered largely in their own right, there is a bigger set of hydrological, economic and political implications of China's development within its own territory that seems to be pushing inevitably toward construction of dams on the lower Mekong mainstream. In turn, this is driving a new geopolitics as various players realign based on their position on the mainstream dams.

Second, then, it is clear that the environmental politics around dams on the Mekong mainstream are intricately bound up in a wider world of geopolitics, which include China's emerging relations with regional neighbours. They also include the regional playing-out of competition between older and newer world superpowers. What is notable is the way in which these geopolitics are now enmeshed in resource and environmental concerns over a shared river system.

It would be dangerous to equate path dependency with fatalism over Mekong mainstream dams. Important decisions are yet to be made. It would equally be wrong to consider that environmental considerations are subject and subsidiary to dominant geopolitical concerns and that international relations rather than concern for a shared river system entirely rule the game. The recent publication by MRC of the Strategic Environmental Assessment (SEA) report on the lower Mekong mainstream dams, which recommends a 10-year moratorium on the 11 projects, presents an opportunity for the countries of the region to move beyond the path dependency that sees one dam leading to another and another, until the river becomes a cascade of still-water lakes – as would be the case for 60% of the length of the lower mainstream if all 11 dams were to go ahead.

A telling decision is imminent that will demonstrate whether or not the cooperative arrangement represented by MRC will take note of the SEA as the most comprehensive scientific assessment to date. The first of the mainstream dams, Xayabouri, has been notified for prior consultation by MRC member states over a six-month period to March, 2011. This is the first time that other MRC countries have been asked to give their opinions on a dam proposed in the territory of one of their neighbours. If a deal is done to go ahead with this dam despite the SEA recommendations, this will more than likely open the floodgates for further dams on the mainstream, at enormous cost to the well-being of the millions who depend on the river for their everyday livelihoods.

Ultimately, this outcome is linked to China's actions further upstream, without which it is highly unlikely that the mainstream dams would be under discussion, as they are today.

Philip Hirsch is director of the Australian Mekong Resource Centre.

Image by All Points East

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Chinese power, Burmese politics

China's state-owned energy firms have entwined themselves in Myanmar's internal struggles. Yang Meng finds out more on a visit to the stalled Myitsone dam.

We approached the Myitsone construction site along a new concrete road, laid over the local government's old, rough track by China Power Investment Corporation (CPI). This Chinese state-owned power company is the investor behind this multibillion-dollar hydropower scheme in northern Myanmar, also known as Burma, and its Yunnan-based staff told me I was the first reporter to be granted permission to visit.

A cascade of seven dams is planned for the Irrawaddy River, of which the Myitsone scheme – located 30 kilometres north of the Kachin state capital Myitkyina – is just one. At a total cost of 160 billion yuan (US$25 billion) and with power-generating capacity of 20 gigawatts, this string of dams is set to be China's largest overseas hydropower investment to date. Once the dams are complete, experts say, Myanmar's government will receive tax revenues, free electricity and shares and dividends worth US$54 billion (340 billion yuan). That's more than Myanmar's entire GDP for 2010, which was US$42.9 billion (270 billion yuan).

At least that was the plan. On September 30 last year, events took an unexpected turn. Myanmar's new, nominally civilian president, Thein Sein, believed to be responding to increasingly widespread opposition to the dam across Burmese society, suddenly announced the suspension of the project for at least the term of the current parliament.

Myanmar stands on the brink of great change. The military government that has ruled for half a century is in decline. Aung San Suu Kyi's National League for Democracy is again a political player [editor's note: on Sunday, April 2, the party claimed a landslide victory in by-elections, setting Aung San Suu Kyi on course for a seat in parliament for the first time] while ethnic militias control swaths of the north. Nobody has the upper hand. China is Myanmar's biggest investor, and the big state-owned enterprises that have charged into the country now find themselves caught up in its power struggles.

The situation is comparable to that in Africa, where many Chinese companies have struggled to adapt to changing conditions in the swell of democracy movements. Strategy consulting firm Roland Berger has warnedthat existing practices and guidance from the Chinese government are unable to keep up with the constantly shifting circumstances, or to track and evaluate both international and tribal disputes.

As of the end of July last year, 31 different nations had investments in Myanmar totalling US$36 billion (227 billion yuan) across 12 different sectors, according to the country's Directorate of Investment and Company Administration. China is the largest single investor, accounting for almost US$16 billion (101 billion yuan). China is also Myanmar's largest trading partner – annual trade between the two countries is now worth around US$3.6 billion (23 billion yuan). China's Myanmar-bound exports are largely destined for its investment projects, comprising raw materials and equipment worth over US$2 billion (13 billion yuan). Myanmar meanwhile sends minerals and agricultural products worth US$1.6 billion to China.

These figures are strikingly higher than just 18 months earlier. In January 2010, official statistics put China's investments in Myanmar at no more than US$1.8 billion. The leap is mostly thanks to the arrival of huge state-owned enterprises such as the China National Petroleum Corporation (CNPC) and CPI. Previously, investments came from small and medium-sized firms (SMEs) based over the border in Yunnan. Deals already inked by Chinese firms and the Burmese government will see investment continue to boom in the near future, mostly in hydropower, oil and gas. But those who arrive first will also be the first to hit problems.

Myanmar is rich in water. Three major river systems – including the Irrawaddy – run down the country, from north to south. But the country has never had the infrastructure to exploit these resources. Before travelling to Myanmar, I visited CPI's offices in Kunming, where I watched as CPI Yunnan's president, Li Guanghua, unfolded a map of Myanmar with the course of the Irrawaddy closely annotated. "There are over a dozen Chinese firms, including CPI, working on hydropower in Myanmar," he explained. "We may be based in China, but we compete in Myanmar – almost always with other Chinese firms, and fiercely."

Li Guanghua is a veteran of the power industry and its government regulators. He moved to CPI Yunnan in 2008, by which time the company's Burmese projects had already been under way for two years. In 2006, with the military government in need of relief from international sanctions, Myanmar Power visited CPI in search of investment, and CPI became the first Chinese firm to work on hydropower in Myanmar. But the honeymoon period was brief. Soon, other Chinese firms were flocking to compete for the same projects. The Burmese government realised it could impose harsher conditions and still have a range of partners to choose from.

CPI operates a build-operate-transfer (BOT) model in Myanmar, meaning it will build a hydropower plant, operate it for 50 years and then transfer the whole project to the Burmese. Its cascade of seven dams is tabled to generate a similar amount of power to the Three Gorges Dam.

Under the contract, Myanmar will receive a tenth of the electricity generated for free, while the remainder will be sold to China. There is no need for CPI to obtain the land rights – Myanmar will provide those at no cost. Myanmar will also hold a 15% stake in the project. Li estimates that the project will provide an 8% return on investment, which is normal for hydropower schemes. And, as the project is near the border with Yunnan and the Burmese are waiving export taxes on the electricity, he said it is pretty much the same as building a hydropower dam in Yunnan.

The sudden arrival of 2,000 CPI employees in Myitkyina caused temporary shortages of supplies and price spikes. The situation only calmed down when goods were shipped in from Tengchong, over the Chinese border. The Chinese workers have laid telephone and optical fibre lines running back home, and you can now call the dam site with a Tengchong area code.

An unknown party countered the Chinese advance with a terrorist attack. At 4am on April 17, 2010, a series of bombs exploded at four points within the Chinese camp. In the panic, a Chinese worker was injured as he fell from a building. Chen Kerui, a CPI project officer, pointed to a spot less than five metres from our meeting room. "Part of the roof was blown off. It looked like it was homemade bombs, about the size of a tin of paint," he said. The Burmese military has not solved the case, but soldiers are now stationed around the camp. As we drove towards the dam, we saw soldiers armed with grenades and rocket launchers changing shift.

CPI's Irrawaddy projects are in Kachin state (where the majority of inhabitants belong to the Kachin ethnic group), considered the territory of the anti-government Kachin Independence Army (KIA). A ceasefire signed between the two sides 17 years ago forbade either from entering the other's territory.

But, in May 2011, the Burmese army moved to protect a dam being built by China's Datang Corporation on the Tarpein River. Fighting with the KIA broke out, and continues today.

Fifty-six-year-old Nuoleidan is a former KIA platoon leader who now manages the army base. He opened his belt and showed us three gunshot scars, acquired during battle with the Burmese army: "The Burmese government and the Kachin have been at loggerheads for 60 years. Their army wants to wipe out the Kachin, and we're fighting for complete independence. So the war has to go on."

In January this year, at a hotel in Ruili just over the Chinese border, the Burmese government and the KIA held their second round of talks, to no avail. This was not good news for Chinese companies.

The clock has stopped on the Myitsone dam. Nationalist sentiment is on the rise in this traumatised country and has become more important than the struggle between the government and the ethnic militias. On September 10 and 11 last year, Li Guanghua attended two press conferences held by the Burmese parliament and answered questions from members on the dam. Seven government ministers were present, and were firm that the dam would go ahead. But a public backlash followed and, on September 17, anti-dam protestors gathered in front of the Chinese embassy. Sensing that this could lead to larger protests, the Burmese government had no choice but to call a halt to the dam, catching the CPI by surprise.

"They're all saying we've taken Myanmar's resources, but that's not the case," complained Li Guanghua. "The 10% of electricity we're giving to Myanmar is equivalent to two gigawatts, and the entire country only has three gigawatts of generating capacity. And if that isn't enough, we'll give priority to meeting Myanmar's needs. China's installing massive amounts of capacity every year, this is small change for us. It's not a major resource, we're just doing business and it's nothing but good news for Myanmar. Over a century, there'll be one trillion yuan of profit for Myanmar."

Not everyone in Myanmar agrees. Nairg and Maiparn, two young members of the Ta'ang ethnic group (who number 60,000 according to official statistics) on the Burmese border with Yunnan, both strongly oppose the dam. They are members of the Ta'ang Youth and Students Organization (TYSO). Founded in 1998 and based in Thailand, the TYSO is active on Myanmar's borders with China and Thailand.

"The Chinese companies should listen to what we, the people of Myanmar, say. When their bosses go to Naypyidaw, everyone I know is sure they are carrying suitcases of cash for bribes," said Maiparn.

Nairg concurs. The Irrawaddy basin is heavily populated and much of the country's agricultural land lies on the river's banks, and so many like Nairg worry that the dam will affect harvests. "It's true that Myanmar lacks electricity, but the arrival of the Chinese changes our lives, while most of the benefits go to the government and the Chinese companies," he said. "The army takes the land and fields, and then drives away the people. The people get all the pain."

There are people in China who disagree with Li Guanghua too. Yu Xiaogang, founder of environmental NGO Green Watershed, said that China's six large state-owned power companies have already fully exploited their own country's rivers – and that's why they are looking to Myanmar.

Myanmar is rich in resources – and provides an excellent example of what economists call the "resource curse": countries that rely on the export of resources, in particular oil, diamonds and metals, are likely to suffer low growth, high levels of corruption, a lack of political freedom and frequent conflict.

In September last year, Yu and representatives of two other NGOs went on an investigative trip to

Myitsone. In the report they wrote on their return, they said: "China's large state-owned firms have significant resources and huge amounts of capital, and restrict the development of private enterprise. They set policy, control the market and do not need to worry about environmental and social impacts. Profits are not made public, while public resources are often transferred to the companies."

But Li Guanghua has no time for environmental NGOs. "The environmentalists are all well-fed and clothed; they're not the ones who need to improve their circumstances. There's no need to talk to them."

Yang Meng is a reporter at Bloomberg Businessweek's Chinese edition, where this article was first published.

Image by Rebecca W