Glaciers and climate change in the Karakoram Himalaya: Developments affecting water resources and environmental hazards Outline of Presentation at China Environment Forum February 12, 2009

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Outline of Topics

1. Significance of the Karakoram glaciers
2. Snow and ice covers
3. Recent changes in Karakoram glaciers
4. Context and key issues: thinking vertically
5. Surging glaciers
6. Other glacial hazards
7. Climate change and dams built on the main Indus

MAIN POINTS

Glacier advances, thickening and surges in the Karakoram:

Most reports have mistakenly suggested that these glaciers are 'disappearing''. However, unlike the rest of the Himalaya and most Inner Asian ranges:

i) there has been no net reduction in the ice cover in the last three decades
ii) many glaciers have retreated or thinned slowly but, since 1995, I have found **more than 35 glaciers advancing, mid-glacier thickening in a dozen others, and a sudden increase in glacier surges**

My talk mainly addresses these questions: Why here? Why now? Implications?

Synopsis of recent climate and glacier changes

Seeing climate vertically: glacier environments in the central Karakoram

Points to emphasize:

1. Zone of maximum precipitation, 5,000-6,000 m asl, **entirely within glacier accumulation zone**—and 2,500 m or more higher than in eastern Greater Himalaya of Nepal
2. Snow avalanching and glacier nourishment: at all elevations but **prevailing in accumulation zones**
3. Predominance of ablation-enhancing clean/dusty/dirty ice in largest areas of ablation zone ice; heavy ablation-reducing debris covers in lower ablation zone
4. Altitude dependence of **ice thermal regimes**
5. Climatic change will primarily affect **the heights and vertical extent of controls** and glacier responses

Basic considerations of snow and ice in Indus Basin water supply

Total snow and ice cover and melt water production are much less important than:

i) the bulk of meltwater yield coincides with the Summer monsoon
ii) 90% of glacier melt comes in about 2 months of the year; 90% of snow and glacier melting in about 3 months -- most of it goes to the sea!

iii) Variability of summer weather: huge ups and downs of water yield between sunny (high flows) and stormy (low flows) weather

--in most years, less glacier melt means higher monsoon rains, but 'worst-case scenarios' when both are high (major flood years), or both low (major droughts)

iv) 'Shoulder season' yields; critical for agriculture, hydropower, dam storage and cities -- only snow melt involved in Spring, only glaciers in Fall

v) The history of natural hazards affecting water supply and infrastructure shows them to have been worst with greater snowfall (avalanching etc), cold (less melting and water availability, shorter summers in UIB) and advancing glaciers (great ice dams, GLOFs, land loss in UIB)

vi) Absent monitoring and poor forecasting capabilities for the glacial regions of the Upper Indus basin

Some other concerns

- Avalanche-fed glaciers
- On-ice dust, dirt and debris
- Snow and ice temperatures
- Seasonal regimes and 'shoulder seasons'
- Glacier hazards
  - GLOFs,
  - Surges
  - Catastrophic rockslides
  - All-hazards approach

Climate change and large dams on the main Indus

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