



Igor Vasilievich Severskiy

## Glacier melt and poor policies behind Central Asia's water woes

Last November, Igor Vasilievich Severskiy was one of 60 experts from 13 countries who called for a regional centre to be established on glacier research, at a workshop run by UNESCO and partners in Almaty (Kazakhstan). Prof. Severskiy heads the Laboratory of Glaciology at Kazakhstan's Institute of Geography, as well as Kazakhstan's National Committee within UNESCO's International Hydrological Programme. He explains why both scientists and policy-makers in Central Asia have a lot to gain from a regional centre on glacier research.

### How fast are glaciers retreating in the mountain ranges of Central Asia?

Several studies presented to the international workshop I attended last November show that glaciers in the Central Asian mountain regions of Dzhunghar Alatau and Pamir-Alai are melting very rapidly. Between 1955 and 2000, they lost about 0.6–0.8% per year in surface area and 0.8–1% in volume. These figures leave no doubt that global warming is the main reason for deglaciation and shrinking snow and ice in Central Asia.

### Is glacier monitoring satisfactory in Central Asia?

There are too many gaps in monitoring. The November workshop acknowledged that the lack of a monitoring system in Central Asia is responsible for inadequate information on glacier mass dynamics. This is a critical problem in the region, since glaciers are key indicators of global climate change. There is practically no monitoring system, for instance, for snow cover in the high-mountain belt above 3000–3200 m, even though this is where about half of snow is concentrated, according to our research. It is this snow which is the main source of runoff in Central Asia. Most countries in the region do not even have regular monitoring of permafrost soils. This lack of factual information on processes and natural phenomena at high altitudes in cold mountain regions forces scientists to use secondary data, indirect methods and to make assumptions when constructing forecast models. This explains the lack of consensus among scientists on the impact of climate change on the region's water resources in general and glaciers in particular.

I believe this was why the workshop participants called for a regional centre on glacier research to be established in Central Asia under the auspices of UNESCO. The centre would promote and coordinate monitoring to improve scientific understanding of climate-driven changes in snow- and icepack in glaciers, in permafrost and in the flow system connecting melt water to rivers and lakes in the lowlands.

### Is it true that glaciers will disappear by mid-century?

There is tremendous concern in scientific literature that Central Asian glaciers may disappear by mid-century. Yet, our research paints a slightly more optimistic scenario. For example, glacier retreat in Northern Tien Shan reached a climax in the mid-1970s before slowing down in the early 1980s. A similar scenario has played out in the Gissar-Alai mountain range. To take another example, glacier upsurge has even been reported in the Central Karakoram mountains, where the glacier advanced by up to 2.5 km along the valleys between 1990 and 2000.

Long-term monitoring of the average annual temperature of permafrost near the mountain pass of Zhushalykezen (3400 m) in the Zailiyskiy Alatau mountain range (Northern Tien Shan) indicates a constant rise in temperature between 1974 and 1995. Thereafter, the temperature stabilized at around  $-0.2^{\circ}\text{C}$  for more than a decade. Moreover, based on our analysis, which takes into account current global warming trends, the glacier area of the Balkhash Basin may shrink by about one-third but will not disappear completely.

These case studies show that glaciers in Central Asia may not disappear as rapidly as predicted. This said, we need updated monitoring systems to improve our understanding before venturing to make any forecast.

### Might glacier lakes turn into hazards by overflowing or bursting their banks?

Yes, that is quite a likely possibility. The hazard might be caused by glacier melt forming a new lake nearby by a swollen lake, or even by disturbances in the stability of loose soils. All three processes considerably increase the probability of mud flows.

### Is glacier melt to blame for the water shortages the lowlands are experiencing?

Water resources management in Central Asia is a critical problem, especially in the Aral Sea Basin. Melt water from

permanent snowfields and glaciers feeds the two main rivers flowing into the Aral Sea Basin, the Syrdarya and Amudarya. These rivers swell mostly in spring and during the thaw in summer.

As early as the beginning of the 1990s, 150% of the natural runoff from the Syrdarya River and 110% of runoff from the Amudarya River was being used up. You may be curious as to why the percentage exceeds 100; this is because the figures also incorporate return flows from agricultural lands.

It is an interesting fact that runoff from the main rivers has remained practically the same over the past 70–80 years. Despite the considerable shrinking of glacier area, water flow into the river system has not changed. Moreover, the cumulative amount of precipitation and maximal snow reserves has shown practically no change either over the same period. The reason for growing water shortages in the region is thus not a case of a drop in the supply of head water but rather of poor water management downstream.

### **In what way is water being poorly managed?**

Poor management of water in the region dates back to the 1960s, when the central Soviet authorities decided to divert unprecedented amounts from the Amudarya and Syrdarya Rivers to irrigate huge cotton plantations. As a result, water shortages in the Syrdarya River Basin rose steeply between 1960 and 1990. In parallel, farmers were encouraged to use more water and dangerous amounts of pesticide and fertilizer.

Yet, even in the 1960s, no more than 25% of the river's natural runoff reached the Aral Sea. This tells us that the human impact on the basin was perceptible long before the so-called "cotton" era. Irrigated farming was well-established in the region as early as the 1930s.

From 1970 to 1989, total water losses in the basin increased by 13.8–14.2 km<sup>3</sup>/year. The climate was responsible for less than 5 km<sup>3</sup> of water loss each year (about 35% of the total), compared to 8–9 km<sup>3</sup> for economic activities. This loss was caused by fast-growing irrigated areas and evaporation loss from the many reservoirs constructed in the region. A further 6 km<sup>3</sup> was lost each year to evaporation from the Arnasaik water storage reservoir alone. Currently, there are about 100 water reservoirs and 24 000 km of irrigated channels in the Aral Sea basin.

Water loss from the Priaralje irrigated area in Kazakhstan increased over the same period from 2.5 km<sup>3</sup> to 4.6 km<sup>3</sup> per year. Today, the Aral Sea is just one-quarter its size 50 years ago.

According to forecasts based on general atmospheric circulation models incorporating the most pessimistic climate scenario, water resources in the region may fall by 20–40% by mid-century.

However, as I said earlier, even as glaciers have retreated, annual runoff in terms of volume and yearly distribution has remained unchanged for several decades. This suggests the existence of a possible compensating mechanism, a hypothesis supported by recent research.

### **What kind of 'compensating mechanism'?**

With global warming, rising temperatures have caused underground ice – in the form of buried glaciers, rock-glaciers and ice accumulated in the permafrost layer – to thaw. This has contributed to the compensating mechanism. As a result, the supply of runoff to the river basin has remained unchanged.

### **Surely, this compensatory mechanism will dry up once the permanent ice has completely melted?**

We believe the compensatory mechanism will work for up to a century, despite glacier retreat. This is because the reserves of underground ice in the high mountains of Kazakhstan and the rest of Central Asia are equivalent to the icepack in present-day glaciers. Moreover, in the Chinese mountains, there is twice as much underground ice as ice storage in the surface glaciers. Another consideration is that underground ice melts at a much slower rate than ice in open glaciers.

Hence, we can predict that the ongoing retreat of glaciers will not cause runoff and water supplies to shrink in the region for a few decades yet. However, this optimistic vision needs additional verification, a task which will require monitoring and more scientific studies coordinated at both the regional and international levels. I believe the proposed regional centre on glacier research will help us to predict with greater accuracy the impact of climate change on glaciers and water supplies in the region.

### **What can central and local governments do to prepare for future water shortages?**

The question warrants serious thought. As a matter of fact, a great number of programmes and studies have already tackled these policy issues, including some global projects. Most of their recommendations concern improving the system for managing regional water resources. There have been recommendations, for instance, to substitute cotton and rice for less thirsty crops in irrigated farming, such as wheat and other cereals.

Unfortunately, in spite of the efforts by regional governments and the international community, the situation as regards regional water-sharing remains tense and is even deteriorating. New water reservoirs are still being constructed and irrigated areas continue to grow in the basin. In parallel, population growth remains high.

The situation is further aggravated by internal issues. For one thing, individual countries lack clearly defined water strategies. On top of that, there is no legislative basis for the transboundary management of shared water resources, nor any mutually acceptable criteria for transboundary water-sharing.

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