The Environmental Food Crisis in Asia – a 'blue revolution' in water efficiency is needed to adapt to Asia's looming water crisis

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The water towers of the Hindu Kush-Himalayas, the Pamir, Tian Shan, and Kunlun Shan mountain ranges, constitute the primary water resources for a large part of Asia's population and food production. The majority of the water, some 75 to 90%, is used in food production. However, while many people and farmers are already challenged by seasonal water scarcity and disrupted monsoon patterns, the reliability of the overall water supply is at growing risk.

There are three major reasons why water scarcity is going to increase. Firstly, population growth is increasing the demand for water, and although only 10 to 25% of the water is used for households and industry, rising populations will also raise the agricultural production demand for water. Secondly, the higher demand for cereals for production of animal feed and for human consumption will increase water demand by an additional 30 to 50% in a few decades; and perhaps by 70 to 80% by 2050. Thirdly, climate change may not only disrupt monsoon patterns, it may also significantly alter the main flow and seasonality of many of the large Asian rivers within a few decades, with disastrous impacts on food production as a result.

Nearly 100,000 children are born every day in Asia

The demand for food and irrigation water will continue to increase towards 2050 as a result of population growth of an additional one billion people in Asia, increased incomes, and growing consumption of meat. In Pakistan, for example, one of the countries with the highest water scarcity and extreme dependency upon the Indus River, the population is projected to increase from around 184 million in 2010 to around 335 million by 2050, an 82% increase. By then, meat consumption per capita will have doubled worldwide and over half of the world's cereals will be used to feed livestock, up from one-third today. Indeed, this cereal alone could have fed the entire projected population growth. Instead, unless changes are made, our water consumption to grow irrigated cereals for animal feed will have to increase by at least 30 to 50%, if not more, simply to support heavily fertiliser-based production schemes. In some regions, as in Pakistan, water demand will increase by 50 to 70% by 2050, and probably before, while availability will at the same time decline. In many regions, this water is already not available in the dry seasons, when it is needed the most.

Reduced amount of glaciers and snow jeopardise Asian and world food production

Irrigated croplands, mainly rice, in the watersheds of the Indus, Ganges, Brahmaputra, Yangtze, Huang He (Yellow River), Tarim, Syr Darya, and Amu Darya are all, to varying extents, dependent on glacial water and snowmelt from the mountains. With rising temperatures, combined with changes in the monsoon, a substantial part of the glaciated area may be lost within this century. While data is sparse in this region, observations from Nepal indicate that current warming at high altitudes is occurring much faster than the global average, up to 0.03°C per year, and even faster at higher altitudes. Scenarios suggest that the effects on rivers are highly variable, ranging from a major increase in the annual flow of the Indus until around 2050 followed by a relatively rapid decline, to a gradual decline in the flow in rivers such as the Brahmaputra. For rivers like the Indus, Syr Darya, and Amu Darya, a major decline in the water flow will have devastating impacts on food production and domestic availability, as there are few, if any, alternatives to this water.

With temperatures projected as continuing to rise, the annual flow of the rivers will invariably decline over time, particularly for those dependent on melting snow and ice, but less so for those more dependent on the monsoon rains. The irrigated cropland in those basins which are the most dependent upon the mountains for water flow, comprises approximately 85,783,000 ha. The average production of irrigated rice is projected at 6 tonnes/ha (range 2-10 tonnes/ha), compared to 2-3 tonnes/ha for non-irrigated land (average of both combined, about 3.3 tonnes/ha in Asia). Water from the Hindu Kush-Himalayas and the central Asian mountain region thus supports the production of over 500 million tonnes of cereals per year, equivalent to nearly 55% of Asia's cereal production and 25% of world production today. By 2050, as projected by FAO, global cereal production needs to be around 3000 million tonnes in order to meet demand. However, due to environmental degradation in the watersheds,

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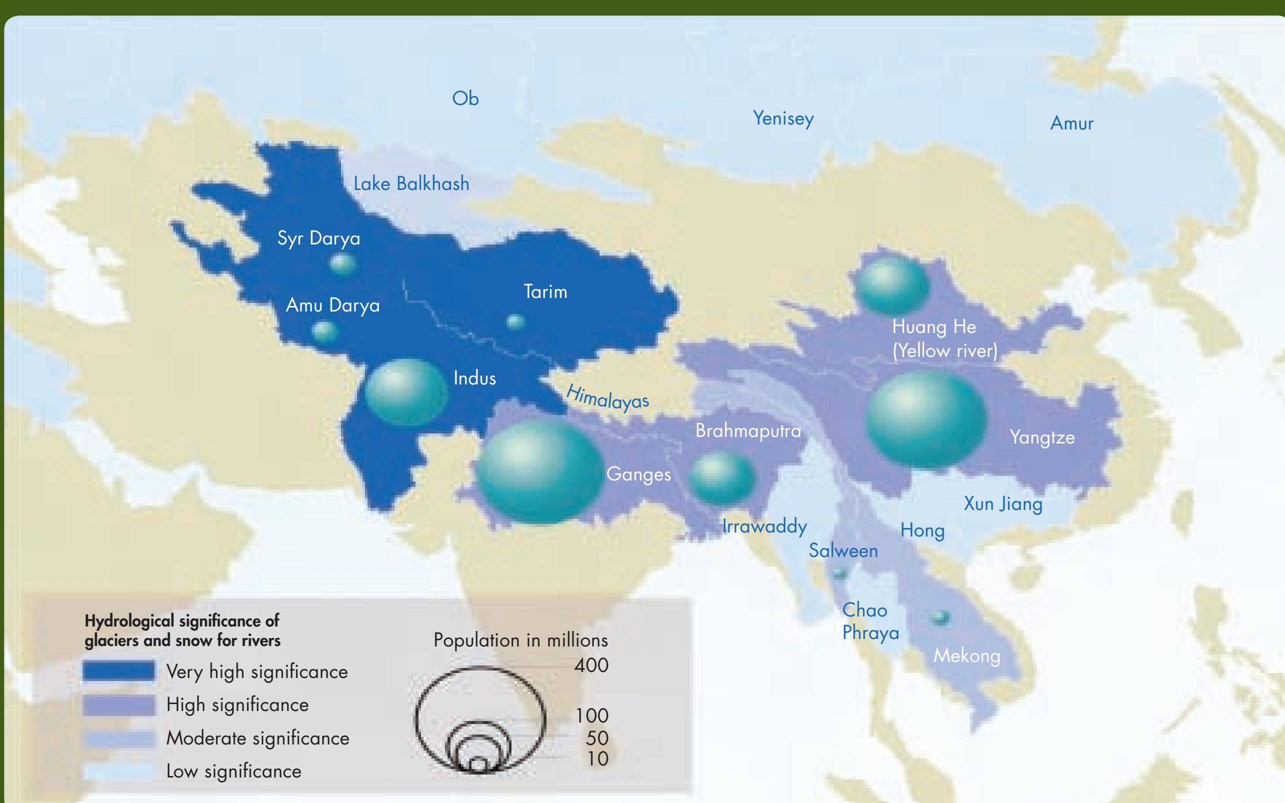
floods, and reduced water flow due to climate change in the Hindu Kush-Himalayas, cereal production in Asia may be at least 10% to 30% lower than projected, corresponding to a 1.7% to 5% reduction globally. Any changes in the water available for irrigation in Asia may thus have a significant impact not only on cereal production in selected countries and regions in Asia, but also on Asia's and the world's entire cereal production.

In countries like Pakistan, the impacts on food production are likely to be far greater, and it is unlikely that the country will be able to maintain the same level of self-

River basins and their hydrological significance

Source: UNEP Global Outlook for Ice and Snow, 2007; Viviroli, D et al. (2003) Assessing the hydrological significance of the world's mountains. *MRD* 23:32-40



sufficiency in food production with the projected decline in water availability. Indeed, with the projections of population growth, water availability per person per year in Pakistan is likely to be reduced by 50 to 70% by 2050 – without assuming any climate change. If, as some projections indicate, water production due to disappearing glaciers and snow in the sources of the Indus declines by up to 50 to 80% beyond 2050, Pakistan would face a potential decline in water availability of up to 80 to 90% per capita compared to today – with devastating effects on food production.

In addition to this, the disappearance of much of the low-lying snow, so important to rangelands at higher altitudes, will severely impact pastoralists, for whom livestock is central for their livelihoods, economy, and culture.

After a long period with declining food prices, the surge in food prices in the last years was the largest and most extreme in more than a century. The ensuing crisis resulted in a 50 to 200% increase in selected commodity prices, drove 110 million people into poverty, and added 44 million more to the undernourished on a worldwide basis. Elevated food prices have had dramatic impacts on lives and livelihoods, including increased infant and child mortality, and on those already undernourished or living in poverty who are spending 70 to 80% of their daily income on food. Key causes of the current food crisis were the combined effects of speculation in food stocks, extreme weather events, low cereal stocks, growth in biofuels competing for cropland, and high oil prices.

Greater price volatility ahead unless challenged

Decreased agricultural productivity and high demand could result in increased prices, create price volatility, and subsequently lead to hunger. Indeed, based on estimates from the World Bank, FAO, and the UN Environment Programme, coupled with scenarios of the environmental food crisis, food prices may increase by 30 to 50% on average – in addition to greater volatility. Large numbers of the world's small-scale farmers, particularly in Bangladesh, China, India, Nepal, and Pakistan, are constrained by access to markets and the high price of inputs such as fertilisers and seed. With

Farmers in Bhutan planting rice (below) and showing their strawberry harvest (right)

lack of infrastructure, investments, and reliable institutions (e.g., for water provision), and the low availability of micro-finance, it will become difficult to increase crop production in those regions where it is needed the most unless this is given major priority. Irrigation water was crucial in the former 'Green Revolution' based on fertiliser increase. Without a 'blue revolution' ahead, not only future production, but even previous gains may be off-set. Moreover, trade and urbanisation also change the food habits of consumers, and the supply from the hinterland of

many developing countries may become insufficient unless major investments in agricultural water efficiency can take place, and may, even then, be an enormous challenge.

Half of the world's food, and even more of the water, is wasted

In addition to increasing production, we can also learn from experiences in the conventional energy sector. In the 1970s, high oil prices led to increased research into more energy efficient houses, cars, and industry. Similarly, rather than focusing solely on increasing production, there is a huge potential for improving food security through optimising food energy efficiency and water efficiency. Food energy efficiency is about our ability to minimise the loss of energy in food from harvesting through processing, to actual consumption and recycling. Today, nearly half of the food produced, and even more of the irrigation water, is wasted in some form through inefficient use.

One of the chief challenges in the coming decades will be to capture and store excess water during periods of high water availability. We are likely to experience more extreme droughts, as well as extreme events of rainfall. New and more effective systems in both capturing and storing water will become essential. This means both improved land management and improved storage methods. It includes, as possible options, the installation of new water capture and storage methods, as well as the re-introduction of some of the ancient traditional storage systems, such as the qanat, foggara, karez, and falaj systems known from desert regions. It also includes irrigation systems and pipelines from major rivers, as deforestation frequently increases the rate and speed of the flow of water into major channels. The required training, the revival of old knowledge, and implementation will require funds and programmes directed towards adaptation.

A 'green economy' may feed the world by reducing water and food waste through increased efficiency

A concerted effort will be required to feed Asia and to ensure the platform of its productivity. A 'green economy' in Asia could provide society, business, and policymakers the room to provide innovative and progress-oriented ideas that may help to provide the basis of a more sustainable future for generations to come.

Firstly, developing alternatives to the use of cereal in animal feed, such as by recycling waste and using fish discards, could meet the demand for the projected population growth of nearly one billion people in Asia. Secondly, in addition to slowing down climate change and environmental degradation, the boosting of small-scale farmer productivity could both improve food security and generate small-scale business opportunities. Furthermore, a major shift to more eco-based production and reversing land degradation would help limit the spread of invasive species, conserve biodiversity and ecosystem services, and greatly help reduce the losses of water in inefficient irrigation systems. Thirdly, investments in green, small-scale technology and development, and the implementation of improved irrigation systems, designed to optimise the water irrigation exactly according to plant demand, reducing evaporation, and reducing run-offs, could likely increase efficiency in water usage several-fold. It is expected that major changes and efficiency improvements in the agricultural sector will take decades to implement. The time frame for implementation now is probably less than a couple of decades. In order to sustain populations we need a revolution in Asia – a 'blue revolution' of water efficiency.