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Climate Change and Water in the Hindu Kush Himalayas

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Key Points

- Climate change poses a major threat to the watersheds of the Hindu Kush region of the Himalayas (HKH). Increasing temperatures are likely to exacerbate existing trends, which cause low water levels in the summer and floods in the winter.
- Other anthropogenic activities also contribute to water scarcity and floods in the HKH, including agriculture, urbanisation and deforestation.
- More data is desperately needed to assess the water resources of the HKH and how they are affected by human activity.
- Water crises are already affecting communities in the HKH and as human activity continues to degrade water resources, the poorest of them will be the hardest hit.

Summary

The HKH is very important to the planet and human livelihoods. It hosts a complex ecosystem with unique biodiversity and ten river systems. It spreads across 16 countries and influences the monsoon seasons in Asia. The future of the HKH, however, is under threat from a variety of anthropogenic sources. Climate change, in particular, is likely to pose an intractable problem. Even at the lower limit set by the Paris Agreement, 1.5^{o} C, predictions indicate that rapid glacial melting and extreme weather will increase water insecurity across the region. Similarly, local human activity has already caused a number of problematic changes to the hydrology of the region, which have exacerbated the summer dryness and

winter floods that are common in the HKH. These effects are also depleting groundwater resources beyond their capacity to recharge. As water resources continue to degrade, the poorest communities are the most likely to suffer severe consequences.

Analysis

The HKH region is of vital importance to the global ecosystem. It is the origin of ten major Asian river systems, supports the livelihoods of over 240 million people and delivers water to 1.9 billion, or a fifth of the world's population. The HKH region covers around 3,500 kilometres, over 16 countries, stretching from Afghanistan to Myanmar and plays a major role in the economic growth of the countries it encompasses. Estimates indicate that the region contains 60,000 km² of glaciers and the world's largest area of land-based, permanent, ice cover, leading some to refer to the region as the "Third Pole." As a result of its complex topography, the HKH substantially influences the East Asian Monsoon and global atmospheric circulation. The region is also highly vulnerable to climate change and other anthropogenic sources of environmental change.

Much of the region that depends on the HKH for water already faces shortages of water, food and energy; this includes much of South Asia and northern China. Half of the HKH rivers face "high" or "extremely high" water stress, or are completely arid. Adding to that stress are the high levels of urbanisation along many of these rivers. Further complexity arises because the ten rivers are shared between 16 countries. Floods occurring in China, for instance, will impact hydropower stations in Nepal, while floods in Nepal will also lead to floods in India. Consequently, to adequately address the ongoing and future needs of the region it is vital that regional actors co-operate closely and that upper riparians consider the needs of their downstream neighbours.

Climate Change

Climate change is likely to present one of the most difficult threats to the HKH. The region has experienced significant warming in recent decades and modelling predictions suggest that this trend will continue in the future. While there are significant data gaps for many parts of the HKH, some trends have been well-established by the existing data. According to a recent report published by the International Centre for Integrated Mountain Development (ICIMD), warming in the region has doubled over the last decade, especially at night, with both minimum and maximum temperatures increasing. Warming in high-elevation areas has been estimated at two to three times the global average. As a result, the HKH has experienced significant glacial retreat, snow melt and permafrost degradation. Since the second half of the 20th Century, 82 per cent of the glacier located in western China has retreated, while the area of the glacier on the Tibetan Plateau has decreased by seven per cent.

An increasingly warm climate also appears to have affected rain and snowfall patterns. Again, the data on the subject is somewhat limited, making it difficult to develop a full understanding of the trend. There certainly appears to have been an increase in extreme

rainfall events and a reduction in mild to moderate rainfall, however, particularly in the Indian subcontinent. Some studies have also found a decrease in monsoon precipitation. Snowfall observations are similarly sparse, but in areas where it is monitored, there has been a consistent and sustained reduction in snow cover. That is problematic, as the extent of snow cover strongly correlates with the volume of downstream discharge when it melts in the spring and summer months.

According to recent studies, even if global warming is limited to 1.5°C (the most ambitious target set by the Paris climate agreement), the HKH will be at least 0.3 °C warmer than the global average. This is likely to accelerate processes that are already underway; a change that is likely to have profound impacts on the region's biodiversity and hydrology, effects which will, of course, vary by region. Since the release of the ICIMD report, the fate of the glaciers in the HKH has been the subject of considerable alarm in media reports. Certainly, glaciers in the region are at considerable risk, even if the rise in global temperatures is constrained to 1.5° C. At this relatively low temperature, around one-third of glacial ice is expected to melt by 2100. Shrinking glaciers are likely to have mixed effects around the region. Initially, projections indicate that this will cause an increase in river runoff as the glaciers melt; however, this is likely to lead to reduced flows by the end of the century, as the glaciers shrink.

The initial increases in glacial runoff are unlikely to be an entirely positive side-effect of glacial melt. As the region has warmed, there has been a significant increase in the number of glacial lakes, which are prone to flooding, especially during monsoons. While these lakes are usually in remote mountain areas, they pose a threat to communities located downstream. As glacial runoff reduces towards the end of the century, it is likely to pose a particular risk to river systems such as the Upper Indus (which draws 62-79 per cent of its flows from glacier and snow melt), the Upper Tarim (42 per cent) and the Ganges (20 per cent). Each of these rivers currently faces "high" or "extremely high" water stress. While rainfall is expected to increase across most basins in the HKH in the short term, the indications are that the Indus and Tarim (along with the Amu Darya) basins will see a reduction.

While the acceleration of glacial melt has captured public attention lately, other hydrological changes are also likely to occur in the HKH as a result of climate change. As mentioned, rainfall across most river basins in the HKH is expected to increase, especially in the Yangtze and Yellow river basins. Increasing rainfall will not necessarily increase available water, however, and may have a negative effect on the water storage capacity of the mountains. This is due to the increased likelihood of flooding caused by a greater volume of runoff, while the increased rainfall will accelerate snow and ice melt. Furthermore, projections indicate that while there is likely to be an increase in precipitation across the region, it is likely to occur due to more extreme (rather than more frequent) rainfall events. Rivers in the HKH are prone to flooding as heavy rains, particularly during the monsoon, can cause rivers in the region to swell to 10 – 20 times their normal flow. As the frequency of incidents involving sudden, heavy rain increases, so will the likelihood of flash floods. Consequently, as precipitation becomes less common outside of the monsoon season and water storage

becomes increasingly compromised, communities will need to adapt to regularly coping with floods and water scarcity.

Development and Urbanisation

Climate change is not solely responsible for the increase in water insecurity around the HKH. The region has seen significant demographic and economic expansion in recent decades, which has increased pressures on land and resources. The HKH has experienced rapid urban growth, with all HKH countries having increased urbanisation rates. Rural populations in these countries are expected to decline and, by 2050, more than half the populations of India, China, Bangladesh, Bhutan, Pakistan and Myanmar are expected to live in cities.

Rapid urbanisation presents several problems for water security and nearly all urban centres in the HKH experience some form of water scarcity. These urban centres were often established by colonial powers on ridgetops, away from the water sources located in the valleys. As a result of their colonial legacies, traditional water systems are often neglected in favour of piped water supplies, which are often outdated and prone to leakage. Urban areas also place high demands on water resources and the piped water is often not sufficient to meet demand, which, in turn, causes lower discharge from rivers and more pressure on groundwater resources. Urban areas are also prone to flooding, for multiple reasons. For example, urban areas tend to drain poorly, due to a lack of convenient drainage areas for excess water Floods pose a particular risk, because urban centres cluster populations into small spaces, increasing the capacity for floods and other disasters to seriously affect large numbers of people. The vulnerability of cities to water insecurity and flooding is particularly alarming, as several of Asia's megacities are located on the rivers of the HKH.

The basins of the HKH have been vital to the development of the economies of their constituent countries, but this development has had disastrous effects on those same basins. Agriculture is vital to the region's development and food security and will continue to be so as the population grows, but current agricultural practices also raise the risk of over-exploiting water resources. Agriculture is the single largest consumer of water in the region, accounting for 83 per cent of the water used.

While much of the region's agricultural land is rain-fed, a significant amount is irrigated. South Asia irrigates around 39 per cent of its croplands and this land has become increasingly dependent on groundwater. The problem is especially pronounced in India, which extracts the most groundwater in the region. It is particularly dangerous in parts of India with low rainfall, where aquifers cannot recharge quickly, leading to over-exploitation. Problems also arise from the types of crops grown. Roughly 50 per cent of calories consumed across the HKH come from wheat and rice, which are both heavily water-intensive crops. Demand for meat has also increased as the region has urbanised, putting further pressure on water resources.

Agriculture, urbanisation and other changes in land use, put further pressure on watersheds in the region. Conversion of forests into agricultural land is a common practice in the HKH and has led to an alarming rate of deforestation. The south-eastern Tibetan Plateau, for instance, was covered in forest until the middle of the twentieth century, by which time it

had been denuded of forest. In addition to this, much of the Indus Basin has been stripped of its forest cover. This not only threatens the region's remarkable biodiversity, but affects the hydrology of the region in a number of ways. Deforestation contributes particularly to erosion, which then contributes to siltation in rivers and reservoirs. This causes river beds to rise and reduces the capacity of reservoirs, which, in turn, both reduces the efficiency of hydropower and contributes to flooding. A loss of native tree cover has also been linked to the drying-up of springs and to reducing the underground water flows that feed non-glacial rivers.

Social Impacts

Ongoing degradation of water resources in the HKH is already affecting the communities that depend on them and will very likely continue to do so through the rest of the century. Climate change, in particular, poses a significant threat to food production, as a result of the increased risk of floods and dryness that it brings. Without significant action on climate change, predictions suggest that crop yields will fall by 30 per cent in South Asia by 2050. Similarly, changes in rainfall patterns are likely to pose serious economic challenges for farmers. Projections indicate that an increase in temperature of 2-3.5^{o}C will lead to a reduction in farm incomes of between 9 and 25 per cent in India. While wealthier farmers may be able to absorb these losses, it is likely to put unbearable strain on poor rural communities.

The water security situation in the HKH is unlikely to be rectified simply, or quickly. It is vital that regional and international players act quickly to prevent disaster for the most vulnerable inhabitants of the region.

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