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Water Security as Part of Non-Traditional Security: Threat-Implications for India

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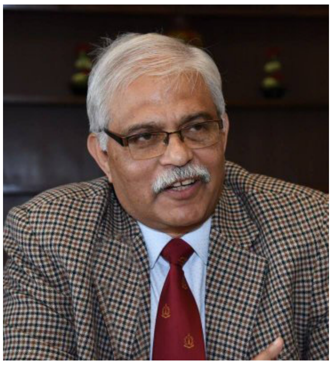


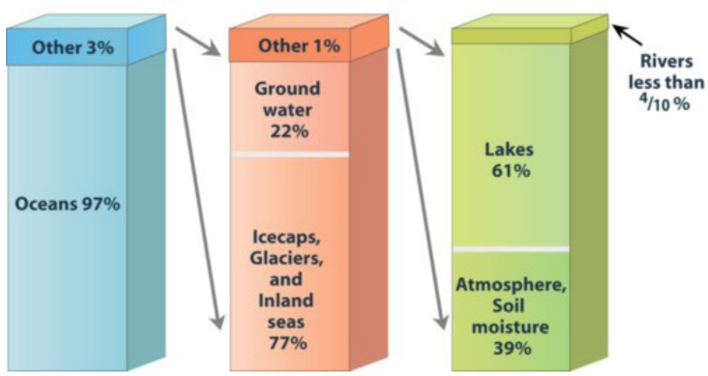
An Electronics and Telecommunication Engineering graduate from BE College, Shibpore, M Tech from IIT, Kharagpur and M. Phil from Madras University Major General PK Mallick, VSM (Retd) was commissioned in the Corps of Signals of Indian Army. The officer has interest in Cyber Warfare, Electronic Warfare, SIGINT and Technology. His last posting before retirement was Senior Directing Staff (Army) at National Defence College, New Delhi. He runs a popular blog on national security issues @ http://strategicstudyindia.blogspot.com/ . Currently, he is a consultant with Vivekananda International Foundation, New Delhi.

Water Security as Part of Non-Traditional Security: Threat- Implications for India

Introduction

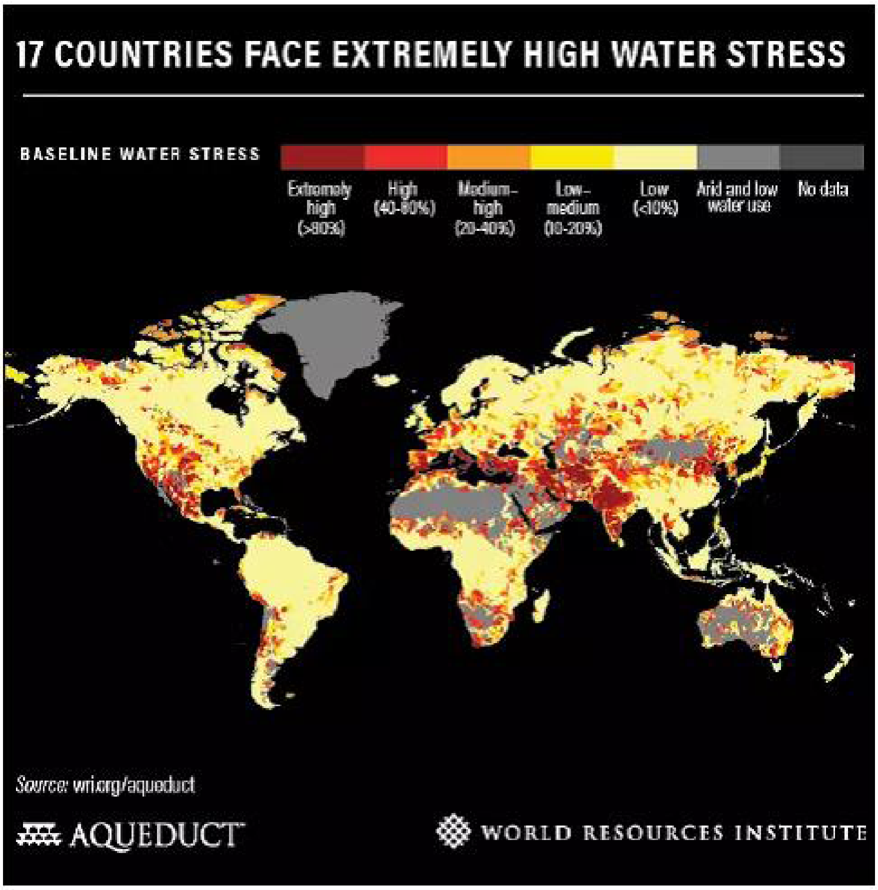
Like oil or data, water is an integral part of the world's economy. Although about 71 per cent of the earth's surface is water-covered, the oceans hold about 96.5 percent of all Earth's water which is salt water. Freshwater, most of it is frozen in glaciers, accounts for the rest. That leaves less than 1 per cent of the world's water available to support human and ecological processes. We withdraw 4.3 trillion cubic meters of freshwater every year from the earth's water basins. We use it in agriculture, which accounts for 70 per cent of the withdrawals. Industry and households consume 19 per cent and 11 per cent, respectively. However, these percentages fluctuate widely across the globe. In the United States, industrial and agricultural usage is almost the same around 40 per cent. In India, agriculture uses 90 per cent of water withdrawals, while only 2 per cent is consumed by industry. Over the past century, rate of withdrawal of available freshwater resources have risen almost six times, outpacing global population growth.[1]

Distribution of Water on Earth



Source: https://courses.lumenlearning.com/sanjac-earthscience/chapter/water-on-earth/

Worldwide while the demand for freshwater has been rising rapidly, the supply has been steadily decreasing. In the 20th century, the world's population quadrupled, but water use increased six-fold. There are increased allocations of groundwater and surface water for the agriculture, domestic and industrial sectors. The strain is already visible. In 2018, Cape Town in South Africa, amid a severe drought, came close to experiencing a so-called Day Zero, where the city would have run out of water. As per UN estimates, by 2050, one in four people may live in a country affected by chronic freshwater shortages. The World Bank estimates that the crisis could slow GDP by 6 per cent in some countries by 2050.[2]



Source: https://www.weforum.org/agenda/2020/09/climate-change-impact-water-security-risk/#:~:text=From erratic rainfall to severe, experiencing "high" water …

Managing Water

Water Crisis

Water shortage and excess cause the most damaging natural disasters. Almost 75 percent of all natural disasters between 2001 and 2018 were water-related. In the past 20 years floods and droughts affected over three billion people and produced economic damage of almost US$700billion.[3] Shortage of access to safe water at home can have disastrous consequences for people's health, productivity and labour participation.[4] In addition to water shortages and water excess, deterioration in water quality causes additional costs for governments, businesses and communities, through harmful impacts on the quality of soil, fisheries and human health.

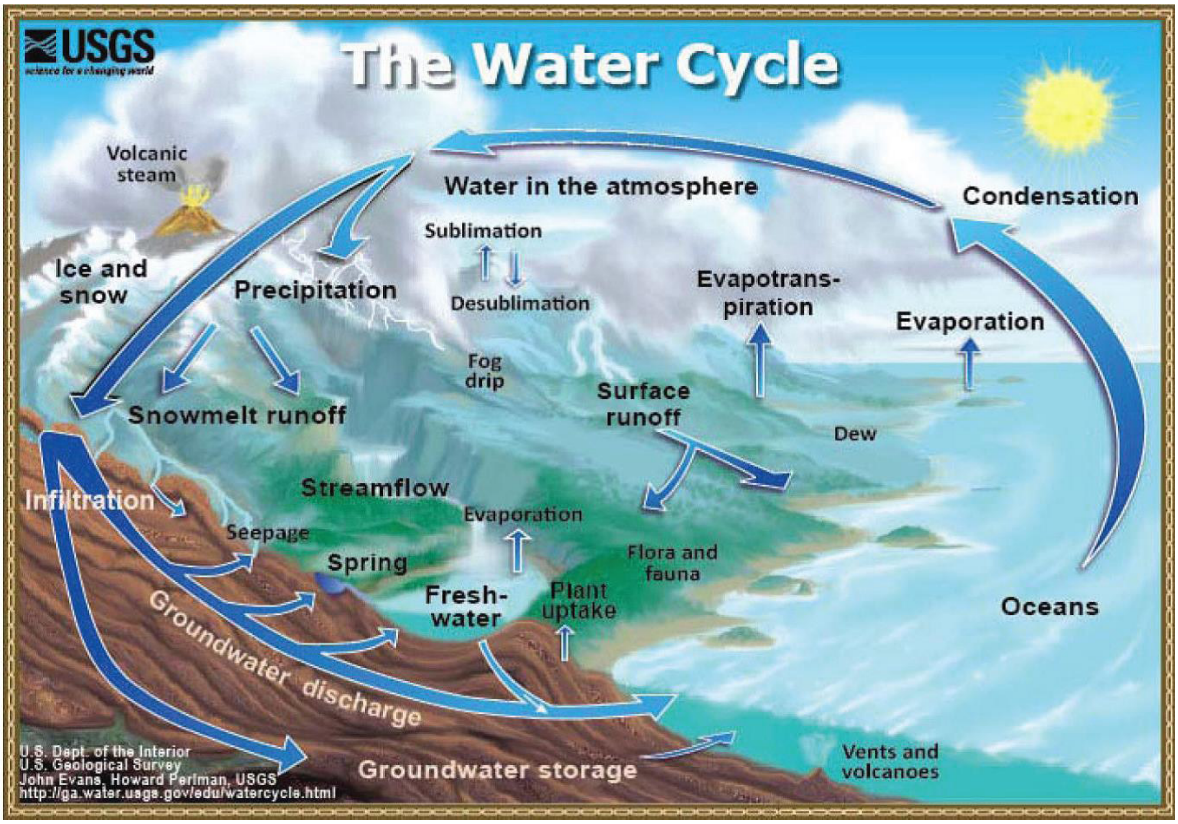
The value of water systems is much beyond the direct use for essential domestic purposes and economic activities. Water ecosystems, including wetlands and watersheds contribute a range of services that are essential for human life. With the rise in the world's population and climate change bringing erratic rainfall and severe droughts, competition for scarcer water worldwide is growing, with water-related conflicts on the rise. Data from the World Resources Institute highlights 17 countries that face extremely high water stress.[5]

Freshwater is a fundamental resource in our world, even more than crude oil. Without freshwater, it would be impossible to maintain the current agricultural production that manages to feed nearly eight billion human beings. Most of the world's agriculture, nowadays, is based on irrigation. It means that production depends on water that has been stored somewhere, naturally or artificially. And once you start depending on a limited stock of resources, you face a problem. Even though your resource may be renewable, if you exploit it faster than it renews itself, you will eventually run out of it. It is the phenomenon called 'over-exploitation'.

The water crisis is defined as "a significant decline in the available quality and quantity of freshwater, resulting in harmful effects on human health and/or economic activity". A study carried out by the International Food Policy Research Institute (IFPRI) found that a decade ago, 36 percent of the world's population was subject to water scarcity. Moreover, this group generated 22 percent of global economic output. By 2050, at the present rate, these proportions would rise to 52 percent of the world population and 45 percent of global GDP.

There is a trans-boundary issue. A World Bank study projected that pollution of rivers in upstream regions could reduce GDP growth in the downstream areas by between 1.4 percent and two percent. Decision-makers are well aware of the seriousness of water-related problems. But they opt to focus on immediate threats, like natural disasters and displacement, rather than the fundamental issues. Water ecosystems, including watersheds and wetlands, are essential for the wellbeing of human life including crop pollination, flood protection, water purification and regulation, erosion control and carbon sequestration.

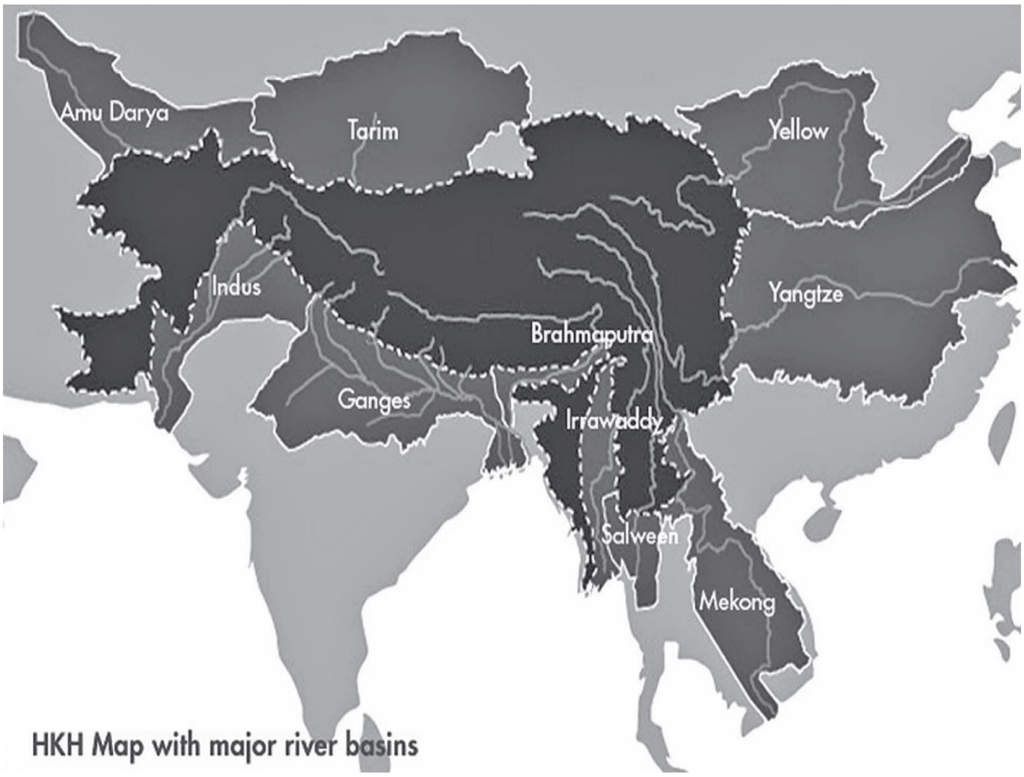
Global Hydrology



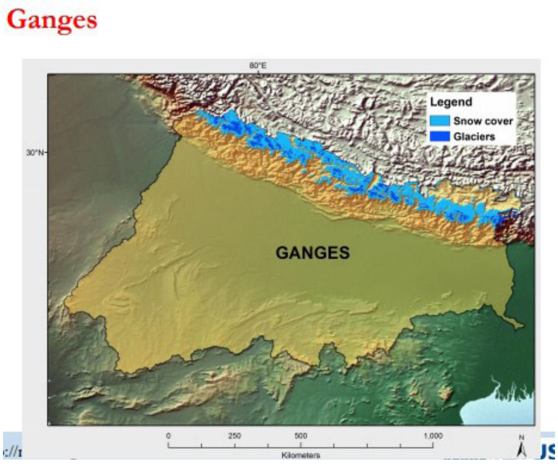
Source: https://www.nap.edu/read/13449/chapter/4

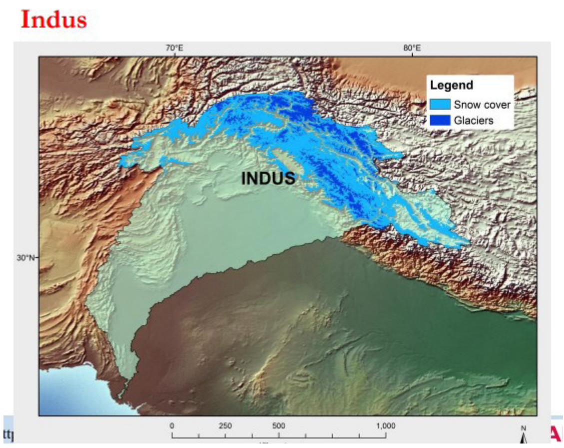
Water Cycle. The global water cycle is how water moves through a chain of reservoirs, including the ocean, lakes, atmosphere, groundwater, glaciers and snowpack. Water can be in the form of solid, liquid or gas in these reservoirs. Water moves from the terrestrial and oceanic reservoirs to the atmosphere through transpiration, evaporation, or sublimation. It moves from the atmosphere to the terrestrial and oceanic reservoirs through precipitation. Precipitation can occur in liquid forms like rain or solid forms like snow, sleet and other types (Reference: U.S. Geological Survey).

Water Basin. A river basin is the portion of land drained by a river and its tributaries. It covers the entire land surface divided and drained by many streams and creeks that flow downhill into one another, eventually into one river. The impact of climate is worldwide, but its effects on water availability are unevenly distributed across basins and regions due to their varying geographical, social and economic conditions. Within trans-boundary basins, the impacts differ between upstream and downstream countries. However, ultimately all countries in the region are expected to face a future with less water.



Major River Basins in Hindu Kush Himalayan (HHK) Region (Note: Dark shade indicates mountain ranges whereas the light shade indicates river systems of the HKH region. Source: ICIMOD, u.d.)





Source: http://nsidc.org/charis

Generally, there is no region-wise strategy to manage water to balance social and economic needs and protection of ecosystems. Agreements between riparian states concentrate on water quantity, water quality, water allocation, flood control, pollution, navigation, border issues, hydropower, fishing, technical cooperation, joint management and economic development. Bilateral agreements may not always be the most effective way of resolving disputes, especially where the parties are unequal.

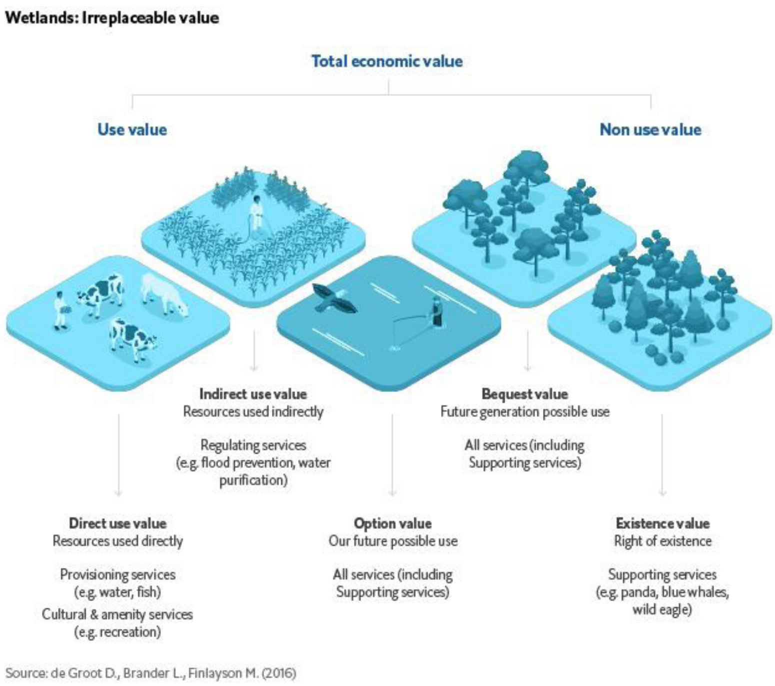
The most suitable geographical unit for the planning and management of water resources is the river basin. Water management at the basin level is done through the Integrated

Water Resource Management (IWRM) approach, which is defined as "a process which promotes the coordinated development and management of water, land and related resources, to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." [6]

There are no set IWRM rules. However, the Dublin Conference (International Conference on Water and Environment, 1992) laid out four guiding principles associated with water use. These are:-

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment;
- Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;
- Women play a central part in the provision, management and safeguarding of water;
- Water has an economic value in all its competing uses and should be recognised as an economic good.

Wetlands.



Source: Under pressure: The economic costs of water stress and mismanagement, The Economist Intelligence Unit Limited, 2021

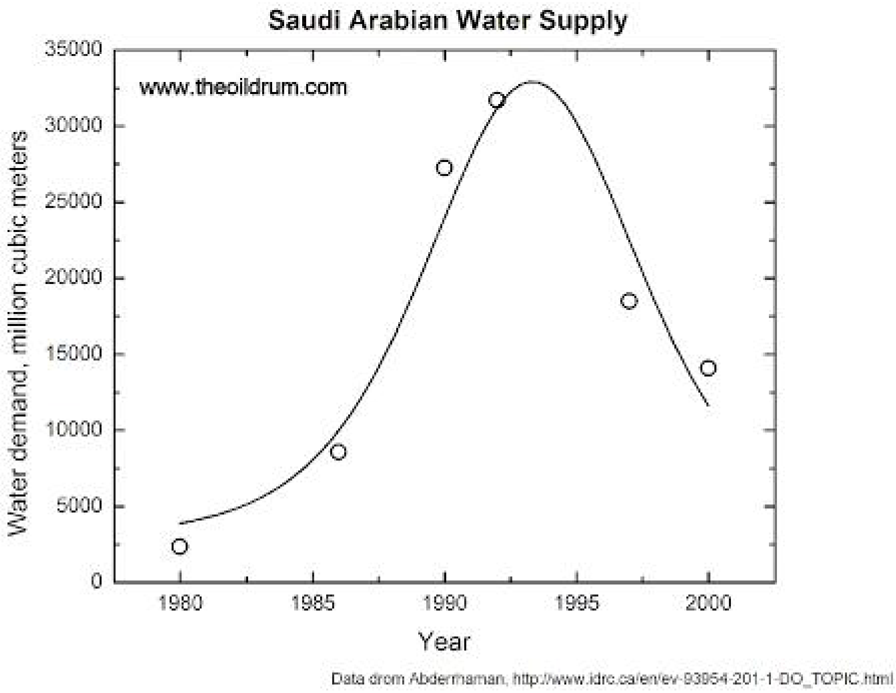
Wetlands are an essential source of water and nutrients necessary for biological productivity and the survival of entire populations. For example, the *Pantanal* is the largest wetland on earth, covering Brazil, Paraguay and Bolivia as a part of the La Plata Basin. More than a 1.2million people depend on it for income, food and drinking water. Millions more get flood protection from it. This wetland is responsible for producing approximately 40 percent of Brazil's soy and more than 20 percent of its cattle. Over 4,700 plant and animal species are home to Pantanal wetland. Pantanal's ecosystem services, including groundwater recharge and sequestration, are valued at $112billion. Even though we knew these benefits, 50 percent of the world's wetlands were destroyed during the 20th century. Since 1970, the population of freshwater species has declined by 83 percent. The destruction of wetlands has caused increased flood and drought damage, water pollution, erosion, nutrient runoff and a decline in wildlife populations.

Biodiversity. Biodiversity is critical for maintaining the health of the complete ecosystem. Loss of biodiversity threatens the structure and proper functioning of the ecosystem, reducing its productivity and lowering the quality of its services. The adverse impacts of biodiversity cause losses on the growth of crops and animals, upon which many populations depend for their livelihoods.

Aquifers. A lot of water used for irrigation is 'fossil water'. This water has been stored underground by natural processes over a long time. Underground water deposits are called 'aquifers'. Natural phenomena fast replenish some. However, mostly the water withdrawal rate is much faster than that of the natural flow into the aquifer. That is a recipe for disaster.

One example of an agricultural region that ran out of fossil water is that of Saudi Arabia. Saudi Arabian farmers started extracting water lying underground for hundreds of thousands of years since the 1980s. The replenishment rate of the aquifers was virtually zero. The result was a boom in agricultural production that quickly peaked in 1990 following an evident bell-shaped curve. Today, Saudi Arabia's agricultural production is reduced to almost zero and all the food is imported.

With aquifers comes the problem of subsidence. Once you remove the water from the porous rock, the rock becomes more compact, and it won't be filled again with water. An effect of subsidence is the habitats may sink into a hole in the ground.



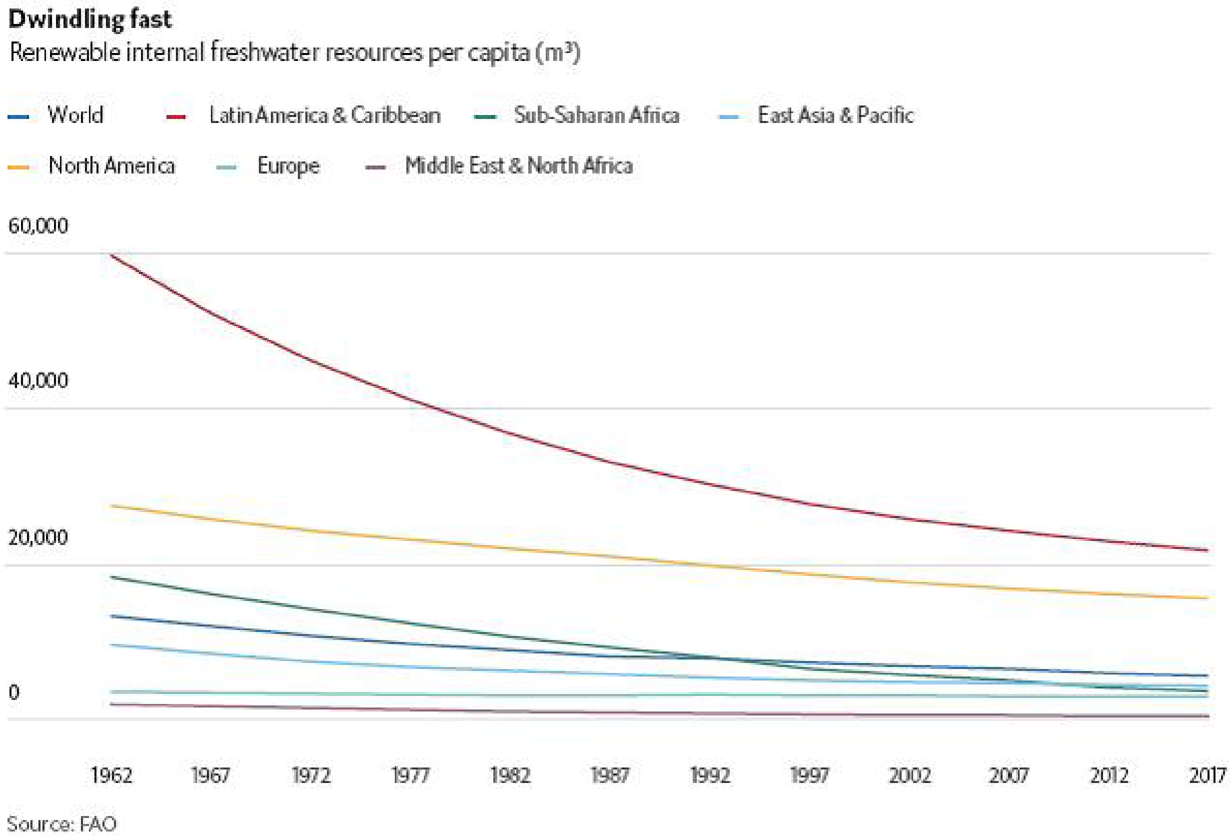
Source: Ugo Bardi, Peak Water: Are We Running Out Of A Critical Resource? 25 April 2021 (econintersect.com/pages/opinion/opinion.php?post=202104252217)

There are a large number of aquifers. Most of them are locally exploited. There is no reliable data available on what is being done in all the regions of the world. New aquifers are also found**.** In 2013, a large aquifer containing 250 billion cubic meters of water was discovered in Kenya. But the water was brackish and not freshwater.[7]

Water Scarcity

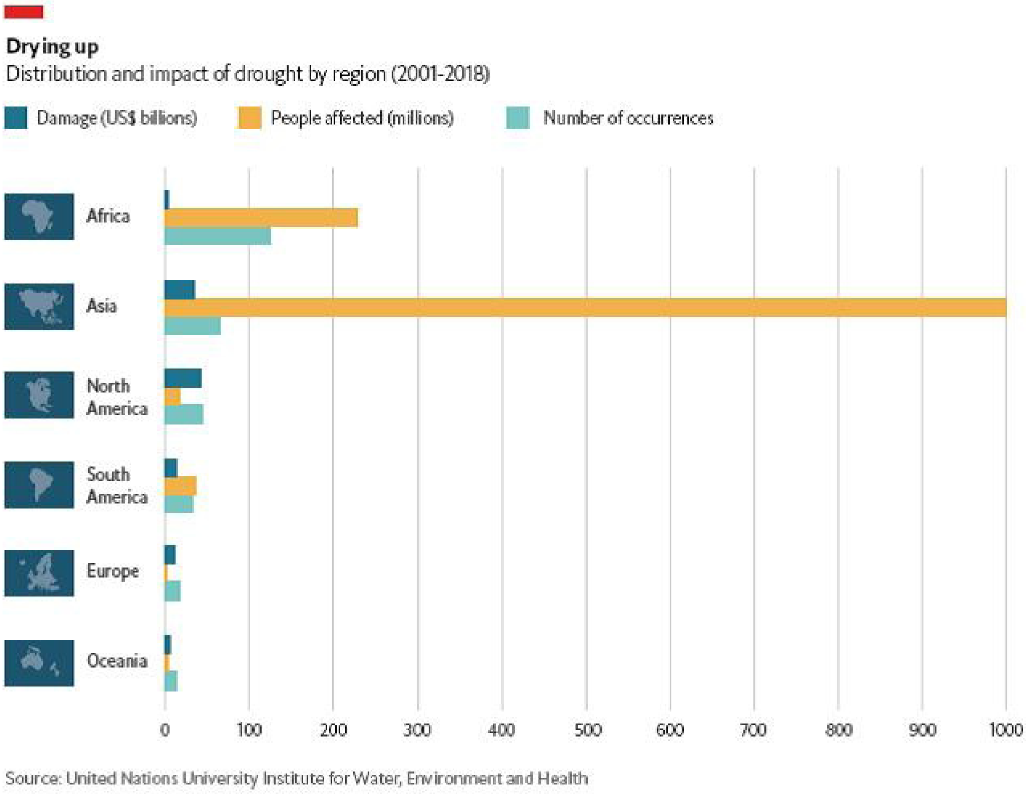
Consumption. Growing pressure on water resources has led to water scarcity in some parts of the world. Our system of daily use of water is inefficient. The available water resources have not been managed well. Increased water scarcity, frequent and severe floods and poor water quality pose a significant risk to the health of communities and ecosystems and global agricultural, energy and industrial systems. We need to restore water's value at the centre of our economies and societies. Over the past 20 years, the good omen is the increase in overall water use has slowed down. On a per-head basis, water consumption has fallen over from a peak of just over 700 litres per person at the end of the 1970s to around 550 litres per person by 2010. However, since new fresh water cannot be created in any significant quantity, the amount available per head keeps falling as the global population rises.

Availability. Water scarcity is defined as the point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully. Water scarcity occurs where water availability in a country or a region is below 1,000 cubic meters per person per year. Water availability of between 1,000–1,600 cubic meters per person per year is seen as water stress. Overall, about 1.2 billion people, or almost one-fifth of the world's population, are estimated to live in areas of physical scarcity and 500 million people are approaching this situation. Another 1.6 billion people face economic water shortages and about 1.6 billion people live in water-scarce basins.



Rising Sea. The current research suggests that the proportion of current land area flooded by rising sea levels by 2050 could be three times greater than earlier thought. This would result in the number of people living below the tide line rising from 110m to 150m by 2150. Living below the tide line is probable and can be secured through the erection of sea walls, barriers and other forms of defence. But constructing such systems would be phenomenally costly. The sea levels would continue to rise.

Drought



Source: Under pressure the economic costs of water stress and mismanagement, The Economist Intelligence Unit Limited, 2021

Scientists suspect that climate change is generating more recurrent and severe droughts. There are many contributory factors to drought, such as temperature, the percentage of precipitation that falls as rain, the accumulation of water in the form of glaciers and the types of vegetation providing ground cover. A comprehensive study published in 2019 by the European Commission showed that the world experienced longer, more severe and more intense droughts during 1981–2016 than over the period 1951–1980. It linked this trend to higher temperatures.

Day Zero

In January 2018, officials in Cape Town announced that the city of about 4 million people was three months away from running out of municipal water. It seemed that Cape Town could become the first large metropolitan city to completely run out of water. Its storage reservoirs went below 20 per cent level. The Cape Town drought was caused by an exceptional consecutive three-year rainfall deficit. April 12, 2018, was the date of the largest drought-induced municipal water failure in modern history. It was labelled 'Day Zero' by local officials. The city's municipal authorities imposed restrictions to delay further decrease to 13.5 per cent, where the city's water supplies would have been disconnected. The city's taps started drying out. There were long queues of people waiting for hours for water.

The city was able to avoid Day Zero through a combination of aggressive water conservation and efficiency measures, smarter use of data and increased rainfall in 2018, courtesy of the mother nature. Cape Town faced the crisis by changing people's behaviour. The administration implemented a 50-litre restriction on water use, making water conservation everyone's responsibility. However, there were unintended consequences that harmed people, like thousands of car-wash workers.

When Day Zero and water shortages disturb the middle class, middle-class solutions are offered, such as private water tankers, shortening showers, less washing of clothes etc. using less water. But, the poor continue to suffer from water stress and shortages after the headlines fade. But the crisis revealed a dismal picture of social inequity. While the rich could afford their own solutions, the deprived had to wait for help from government. For many of them, every day is Day Zero.[8]

Cape Town was not the only one facing such a crisis. Brazil's financial capital São Paulo, a megacity of 21.7 million inhabitants, was down to less than 20 days of water supply and faced its own Day Zero in 2015. The main reservoir fell below 4 percent capacity. The city turned off its water supply for 12 hours a day, forcing many businesses and industries to shut down. It had less than 20 days of water supply and police had to escort water trucks to stop looting. The anomaly is that 12-16 percent of the planet's fresh water is in Brazil. However, most are in the Amazon River and northern rain forests, which was beyond the reach of São Paulo

In 2008, Barcelona had to import tankers full of freshwater from France. Fourteen of the world's 20 megacities are now experiencing water scarcity or drought conditions. Mexico City, Tokyo, Melbourne, Jakarta, Karachi, London, Beijing, Istanbul, Bangalore and the U.S. State of California are among the areas that have struggled with water shortages in recent times.

Long-Term Solutions

The main reasons for the crisis are long-term, such as poor water management, lack of rain and population growth. There is a lack of long-term funding obligations to improve equitable access. The cities generally go for stopgap solutions. For example, cities on sea shore build desalination plants and made commitments to build more. These plants may take years, even decades, to create.

Political Stresses and Water Conflicts

Inter-State Issues

The history of international river disputes and agreement advocates that cooperation is a more likely option than violent conflict. However, recent times have seen a dramatic increase in the number of state and non-state actors, changes in patterns of economic growth, larger populations and the complexity of the challenges. Major worsening in international relations together with intense fluctuations in trans-boundary water flows, perceived by the downstream nation as intentional mismanagement by upstream countries, social media allowing misperceptions to be widely distributed or grave conditions of general water scarcity driven by rising demand and declining groundwater resources may escalate cries of national security crises and tend towards inter-state conflict.

Poor water governance within and between states, precipitation decline, population growth, economic development and inefficient irrigation and agricultural practices will continue to be the leading cause of water stress at least during the next two decades. In addition, in many river basins, upstream countries are building dams and altering water sources with little or no consultation with their downstream neighbours. For example, the Grand Ethiopian Renaissance Dam on River Niles increases the risk of conflict. Besides, an entirely new kind of threat has emerged in the form of cyber- attack. In February, 2021, an unknown hacker attempted to poison a water treatment plant in Oldsmar, Florida, U.S. using the vulnerabilities in the country's water supply system.[9]

There is a growing risk of internal conflict over water resources. For example, India has already seen significant disputes over river water sharing between the states. Specific to the Indian sub-continent, the numbers of stakeholders and interested parties in water resource management have multiplied. This has created new sets of challenges for governance and stability. International treaties may have to adopt a more integrated ecological approach to include management of land, energy and other resources.

Even if there is no catastrophic events, existing water management institutions and treaty arrangements would need to evolve so that cooperation becomes a more likely outcome than conflict.[10]

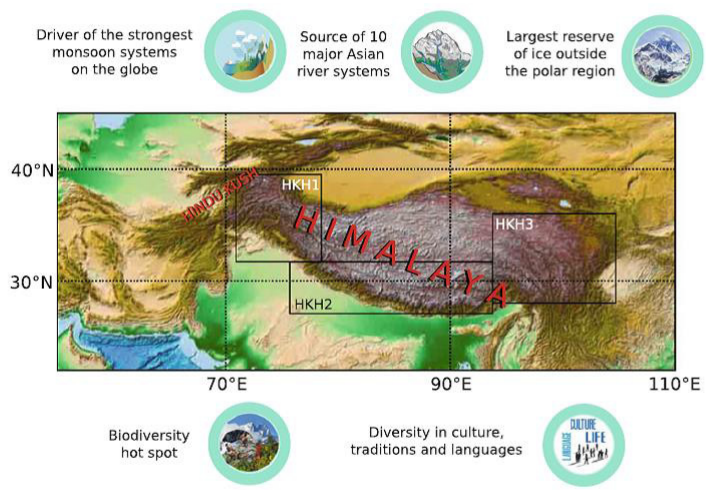
The Hindukush Himalaya (HKH) Region

Himalaya. The name 'Himalaya' means an abode in snow in Sanskrit. The Hindu-Kush

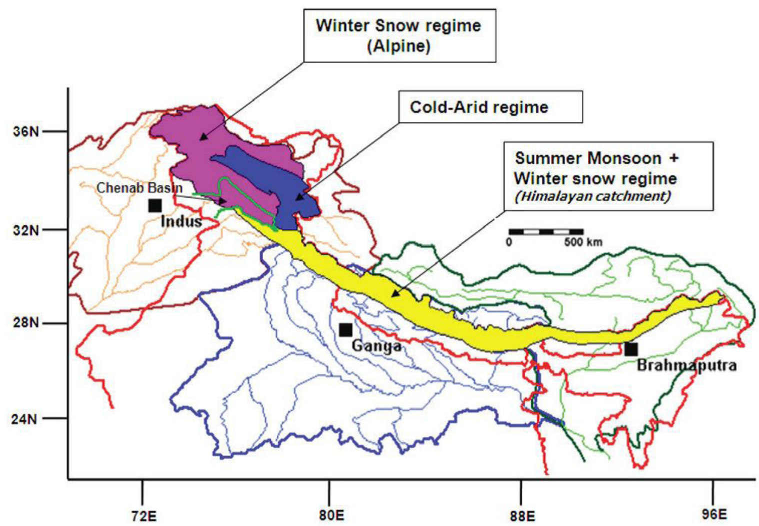
Himalaya (HKH) is known as the ‘Third Pole’” or Asia’s water tower. The HKH range is the world’s tallest and is the home to 10 of the 14 world’s highest peaks. It hosts the largest areas of glaciers, snow and permafrost outside the North Pole and the South Pole. It extends about 3,500 km from Afghanistan in the west to Myanmar and China in the east and runs through the Asian continent spanning several countries of Afghanistan, Pakistan, India, Nepal, Bangladesh, Bhutan and China.

River Systems. The region is the source of ten massive Asian river systems providing irrigation, power and drinking water for an estimated 1.3 billion people, or around 20 per cent of the world’s population. These systems include the Tarim (Dayan), Amu Darya, Indus (including Sutlej), Ganges, Brahmaputra (Yarlung Tsangpo), Irrawaddy, Salween (Nu), Mekong (Lancang), Yangtze (Jinsha), and the Yellow (Huang He) Rivers. Surface water of these rivers and related ground water constitute a significant strategic resource for all of Asia.

Fig. 11.1 Hindu Kush Himalayan (HKH) region and the three sub-regions (rectangular black box) of interest: the northwest Himalaya and Karakoram (HKH1), central Himalaya (HKH2) and southeast Himalaya and Tibetan Plateau (HKH3)



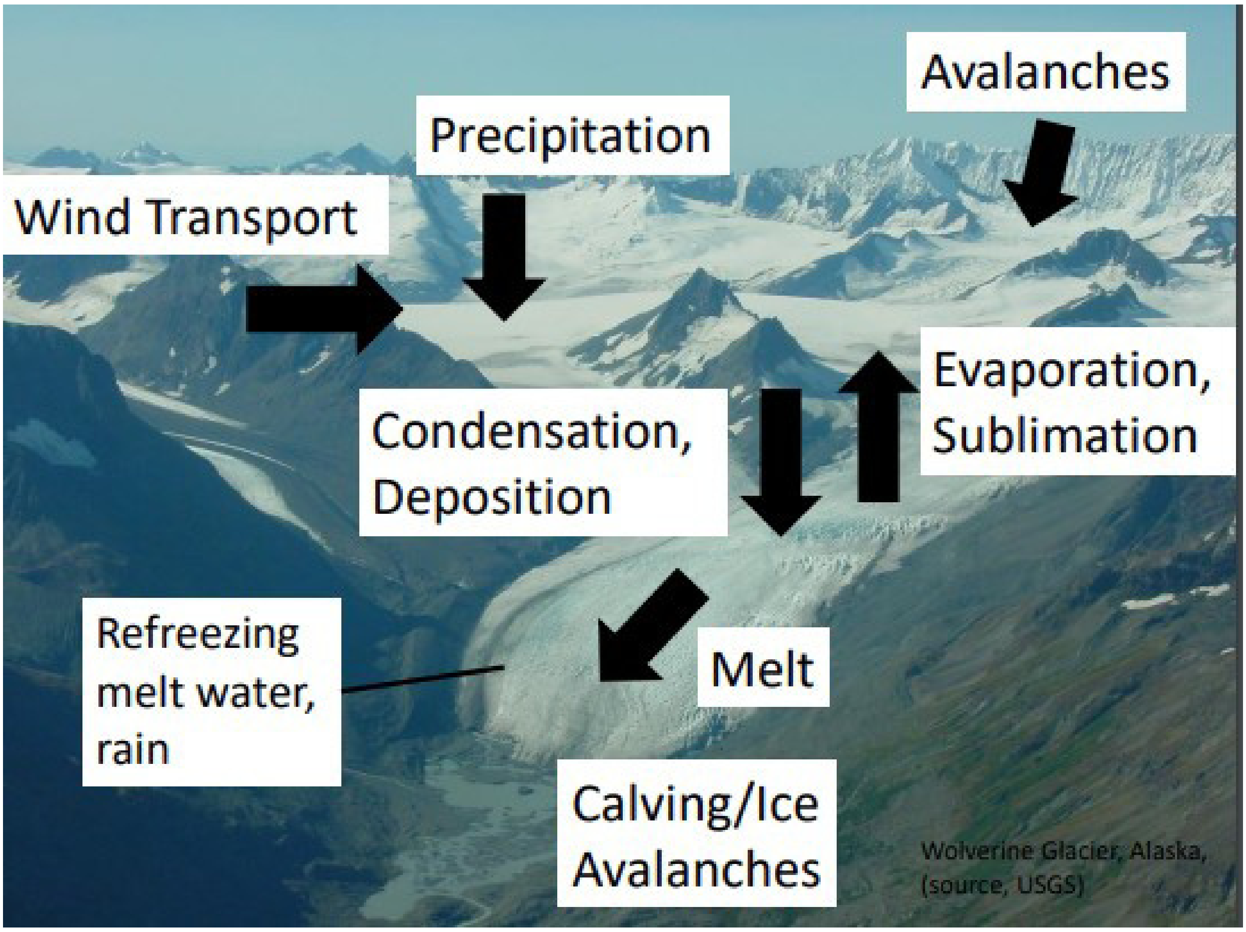
Source: http://nsidc.org/charis



Source: https://www.nap.edu/read/13449/chapter/4

Glaciers. An estimated 15,000 glaciers in the Himalayas store 12,000 cubic km of freshwater, which supports perennial rivers of the HKH region. Glaciers have a zone of amassing in which the volume of the glacier develops and a zone of ablation in which it is lost. A glacier gains mass during the accumulation season, summer in the eastern HKH and winter in the western HKH. During the snowmelt season, summer in both the eastern and western HKH, some or all of that accumulation is lost. During a year the bulk of a glacier may increase, decrease or remain static. It is determined by whether accumulation or ablation predominates or whether they are equal.

Climate. Climate fluctuates across the HKH region. In the west, indicated by purple in the diagram, the climate is alpine and dominated by the mid-latitude Westerly. Maximum precipitation takes the form of winter snow. This area borders a cold arid climate regime, indicated by blue. Indicated by yellow in the east, the summer monsoon dominates the climate, with maximum of the precipitation coming during the summer months. The watersheds of Indus, Ganges and Brahmaputra are also shown in the diagram above.[11]



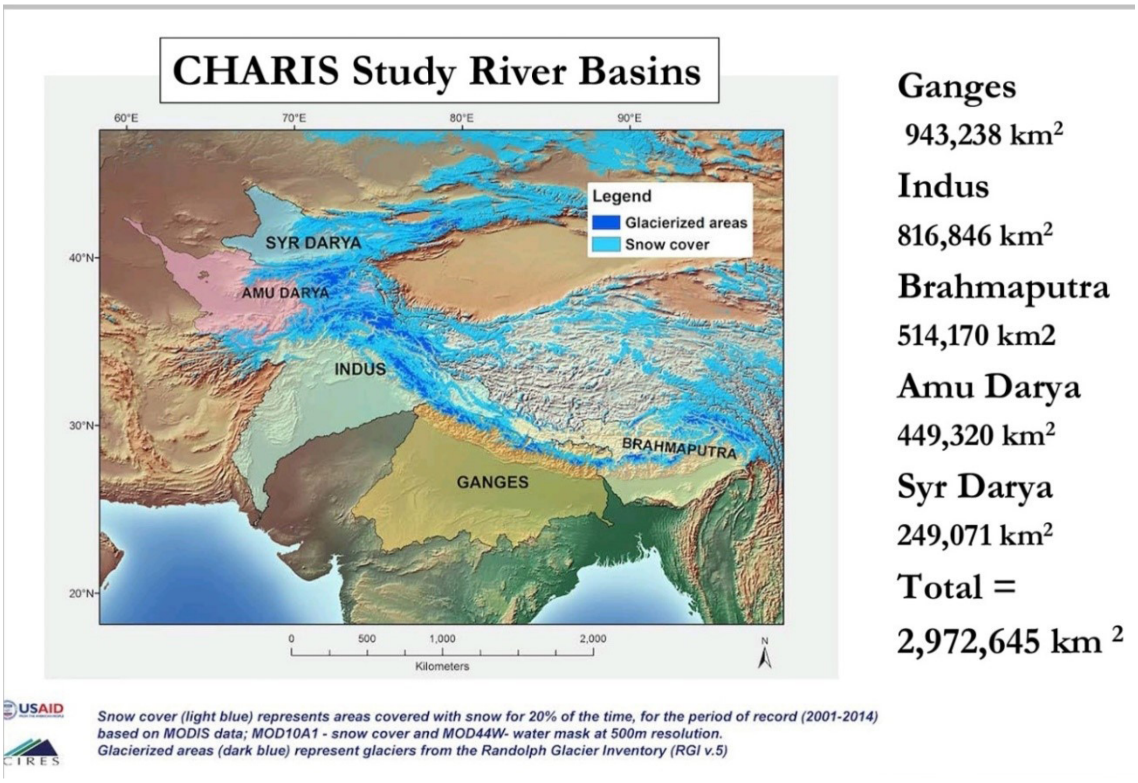
Source : http://nsidc.org/charis

Watersheds. Watersheds of the area each display complex hydrology. The magnitude of the impact of glacial melt-water to the total water supply in these rivers is not yet clear.

Regional Dynamics

While glaciers in the western Himalayas appear to be more stable and may even be advancing, there is evidence of glacial retreat in the eastern and central Himalayas, There are a number of factors like changes in the timing and amounts of monsoonal rain and seasonal snowmelt, snow and ice dynamics, cloudiness, precipitation, aerosol concentration and its effects, black carbon, and the role of tectonic activity, which can cause de-stabilisation of glaciers.

There is scientific evidence to show that the glaciers in the eastern and central part of this region are retreating at rates comparable to those in other parts of the world. They are relatively stable and perhaps even advancing in parts of the western Himalayas.[12]



Source : http://nsidc.org/charis

In 2007 the International Panel on Climate Change incorrectly predicted that all Himalayan glaciers might disappear by 2035. Scientists have challenged this alarmist view with the recently available data after due analysis, experts believe that while glaciers had been melting since the end of the last Ice Age and would continue doing so, the melting had not accelerated in recent decades even if temperatures had risen.[13]

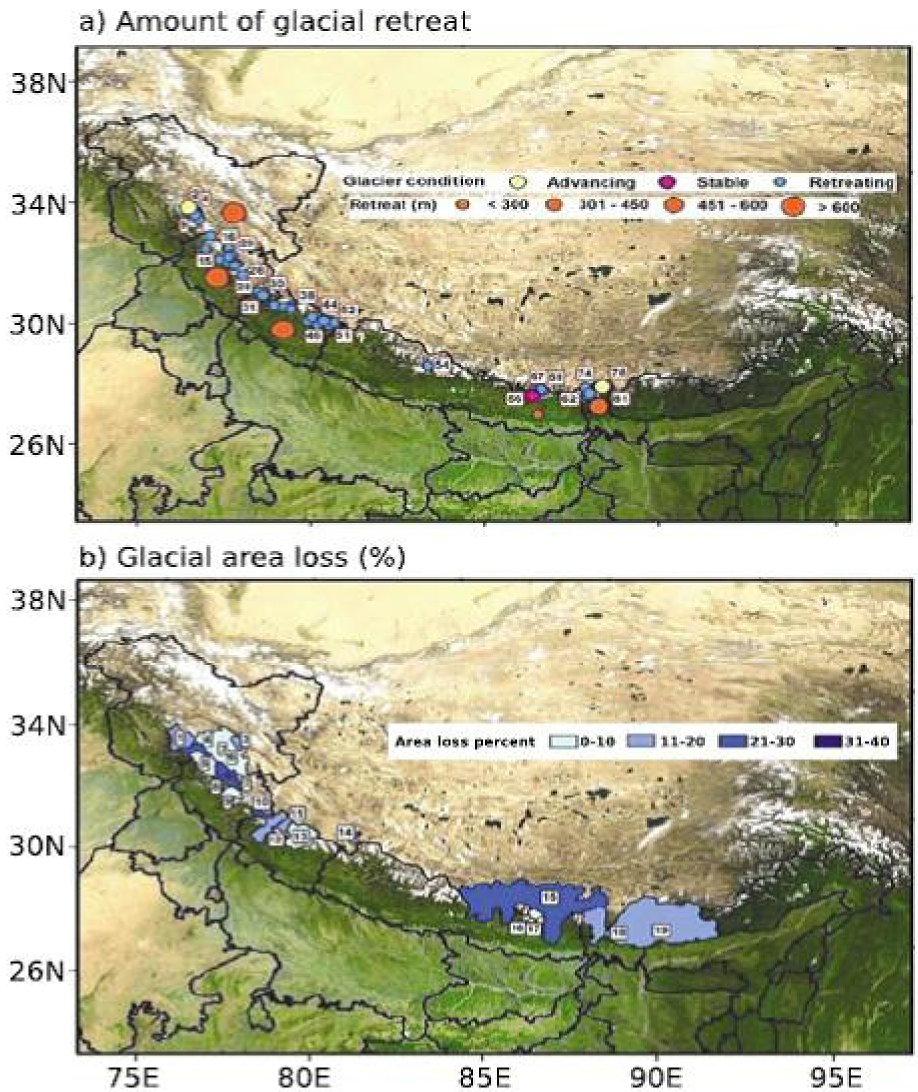
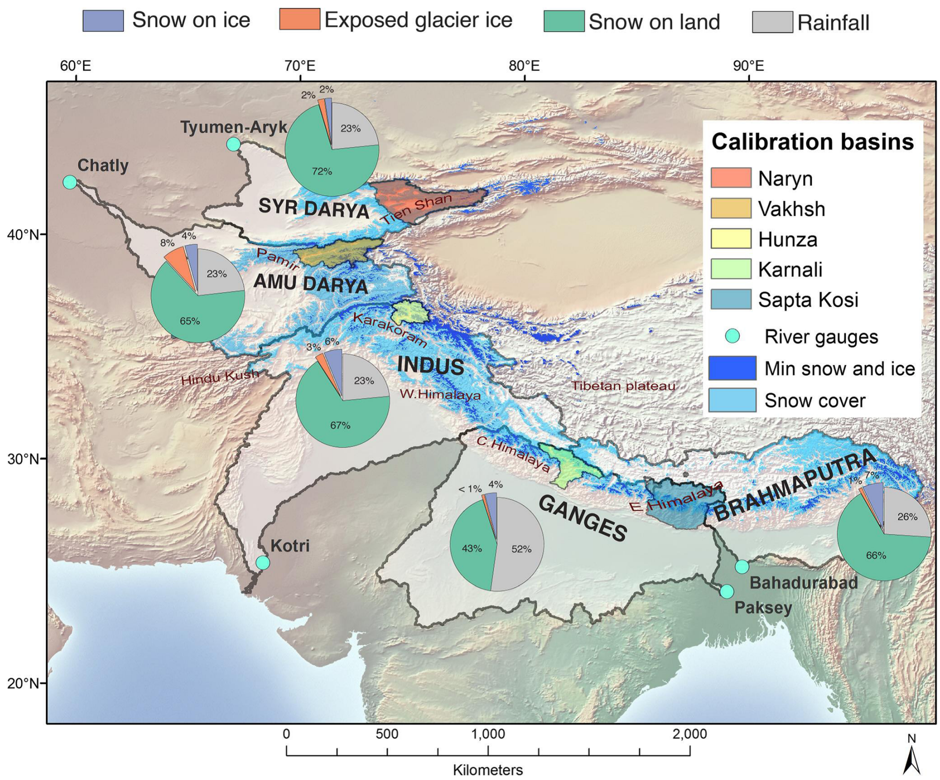


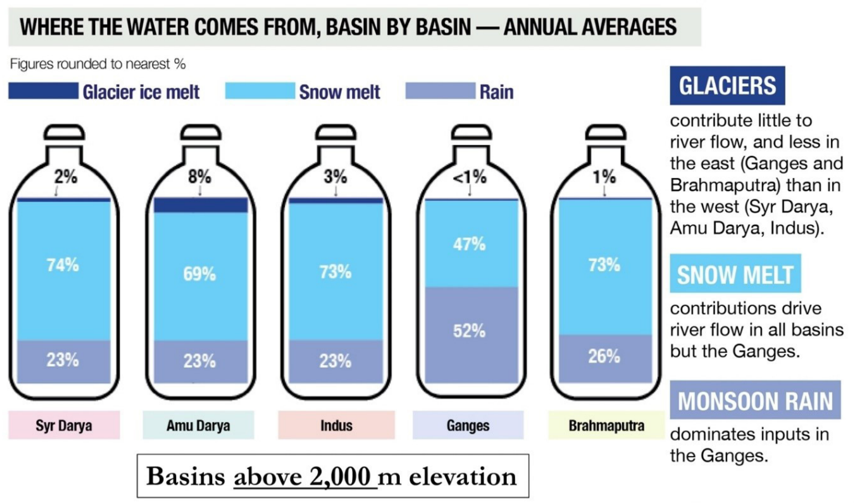
Fig. 11.8 **a** Amount of glacial retreat between 1960 and 2000. **b** Glacial area loss in different regions of the Himalaya from 1960 to 2000. The number represents names of glaciers/basins/regions as given in Tables 1 and 2 of Kulkarni and Karyakarte (2014). From Kulkarni and Karyakarte (2014)

Glacial melt does contribute to the water flow in major rivers such as the Ganges and Indus. However, for low-lying areas such as the Gangetic Plain, percentages are much lower than anticipated earlier. The latest study suggests the earlier researchers could not distinguish between snowmelt and glacial melt because the technology and data were not readily available. But this makes a huge difference.



Source: Richard L. Armstrong, Karl Rittger et al, Runoff from glacier ice and seasonal snow in High Asia: separating melt water sources in river flow, 10 November 2018 available at: https://doi.org/10.1007/s10113-018-1429-0

The effect of the glacial retreat will be most evident during the dry seasons, particularly in the west. Glacial melt-water is not a significant contributor to river systems to the east but is more critical for river systems to the west. The Indian Space Research Organisation (ISRO) has been collecting data by satellite on Himalayan glaciers. ISRO, in its report of 2014, stated that it had monitored 2,018 Himalayan glaciers between 2001 and 2011. It found that only 248 glaciers were retreating, 1,752 were stable and 18 were advancing.



Source: World Resources Institute, http://nsidc.org/charis

The area covered by winter snow is much greater than that covered by glaciers. Even at the snout of glaciers, where rivers emerge, glacial melt is a minor contributor. This keeps falling as the river moves downhill and is fed by rain. Other studies state that most but not all glaciers are retreating. So there is net melting but no cause for alarm.

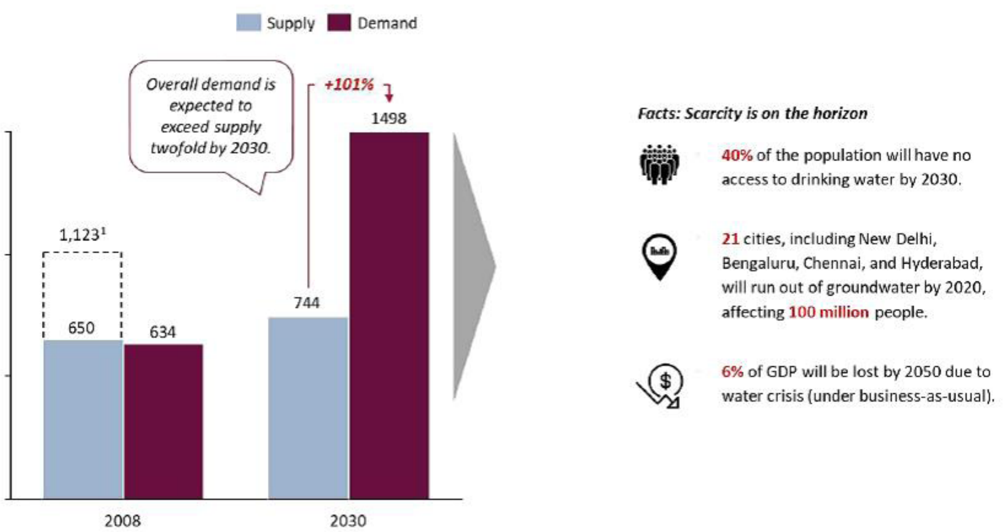
In early summer, snow on land and glaciers starts melting. Snowmelt from high mountains can flow onto the glaciers and be mistaken for glacial melt. After the snow covering glaciers has melted, the exposed glacial ice melts between June and late September. This coincides with the monsoon, which then dominates river flows. Some experts feel that it is a myth that glacial melt is critical for river flow in the lean pre-monsoon season. Instead, it is the snowmelt that is the key contributor.

India Specific Issues

Water Stress

India is severely water-stressed. India has 17 per cent of the world's population and 4 per cent of water. India has about 500 millions of livestock population that accounts for 20 percent of world's livestock population. Currently, 600 million people in India face high to extreme water stress in the country. About three-fourth of the households in the country do not have drinking water at their premises. Water is a state subject and its optimal management and utilisation lies primarily within the domain of the states.

Figure 7: Demand and supply of water in India (forecast)[20,21]
In BCM (2008, 2030)



Notes: 1. Water supply for 2008 is Narsimhan's estimate of 650, while the planning commission estimate is 1,123, as represented by the dashed portion of the graph 2. Demand for 2008 is based on the planning commission's estimates 3. Supply and demand for 2030 are projections by McKinsey and Water Resources Group (WRG)
Source: Dalberg analysis; CWC Water & Related Statistics 2013; FAO & UNICEF, Water in India, 2013; McKinsey & WRG, 'Charting our water future', 2009; World Bank; Times of India

Source: https://niti.gov.in/writereaddata/files/document_publication/Final percent20 Report Delhi.pdf P29.

The crisis is likely to become worse. India was placed thirteenth among the world's 17 'extremely water-stressed' countries, according to the Aqueduct Water Risk Atlas released in 2019 by the World Resources Institute (WRI).[14] By 2030, India's water demand is expected to be twice the available supply, implying severe water scarcity for a very large section of people and an eventual ~6 percent loss in the country's GDP.

India receives abundant water as rainfall during the monsoon. Due to lack of storage facilities, only a tiny percentage of that water is added to the reserve. The total storage capacity of 91 reservoirs of Central Water Commission (CWC) in India is 161.993 BCM. This is nearly 63 percent of the full storage capacity created in the country. There are 3842 water storage structures available in India, having a cumulative capacity of 213.477 BCM. This indicates that approximately 88 per cent of the rainwater goes to waste. India has to conserve every drop of water. With the projected per capita water availability at 1401 m and 1191 m by 2025 and 2050, India will become a water-scarce country.[15]

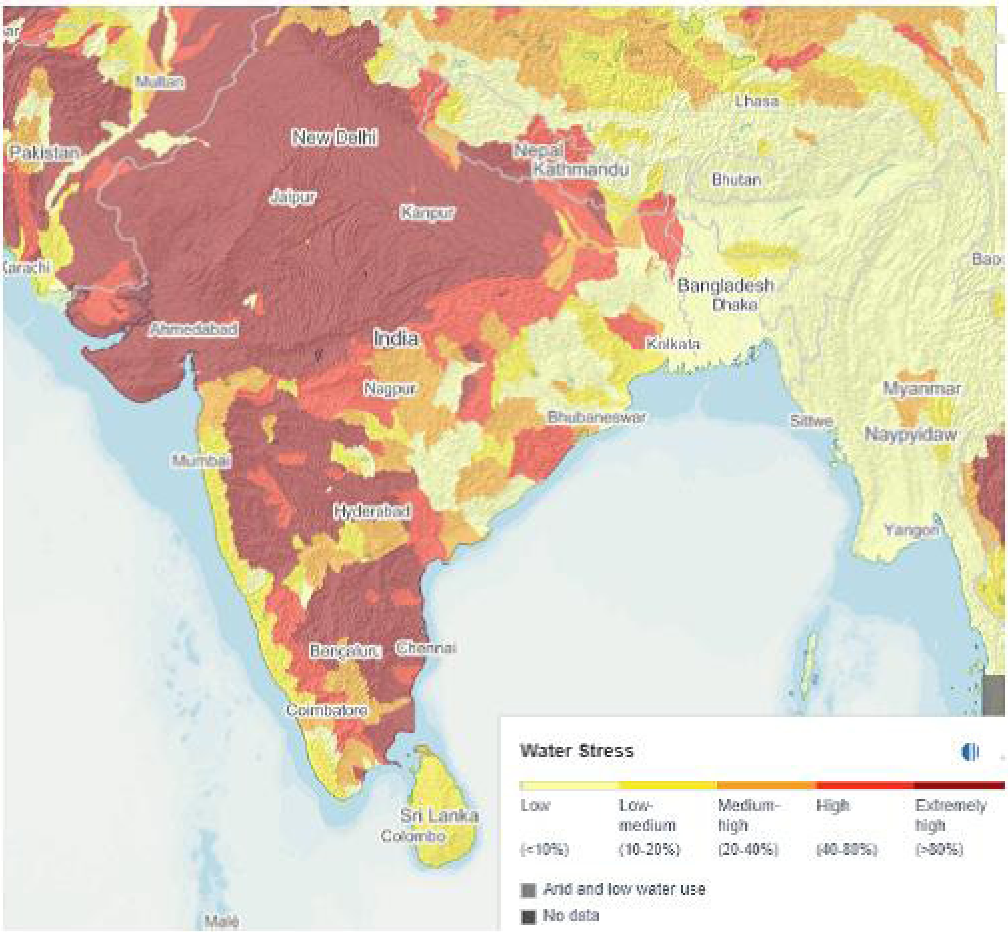
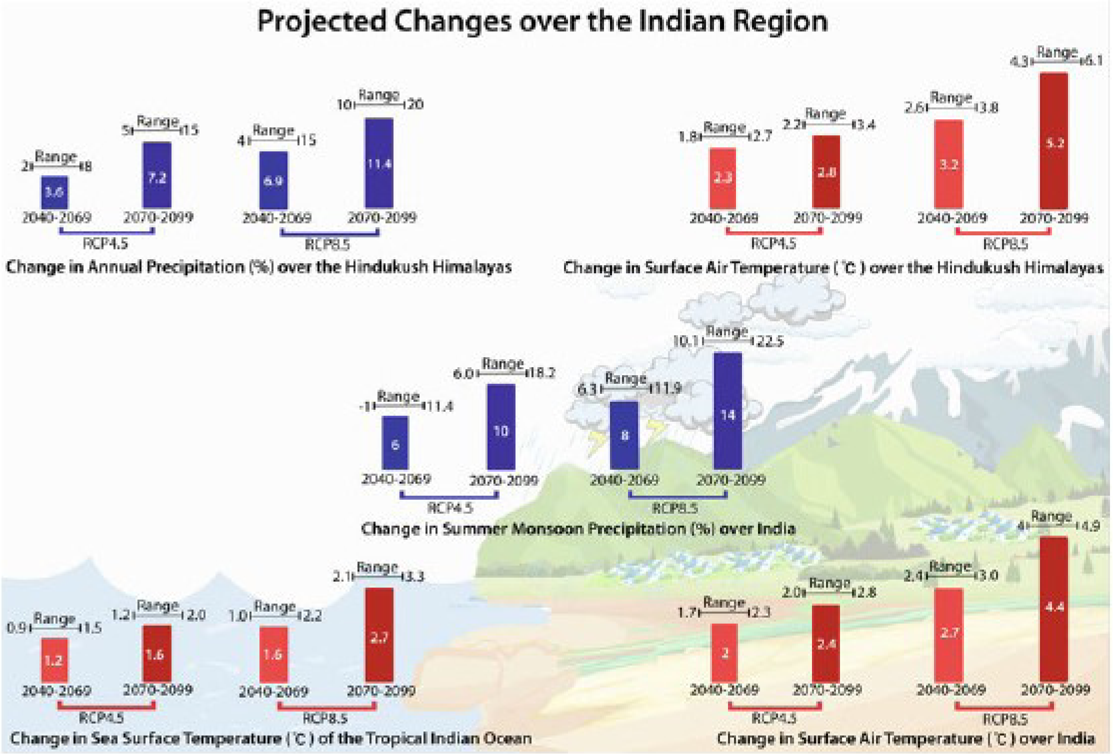


Figure 3: Water-stressed regions in South Asia.

Source: World Resources Institute, *Aqueduct Water Risk Atlas, 2020.*



Source: Assessment of Climate Change over the Indian Region: A Report of the Ministry of Earth Sciences (MoES), Government of India, 2020.

Water Resources

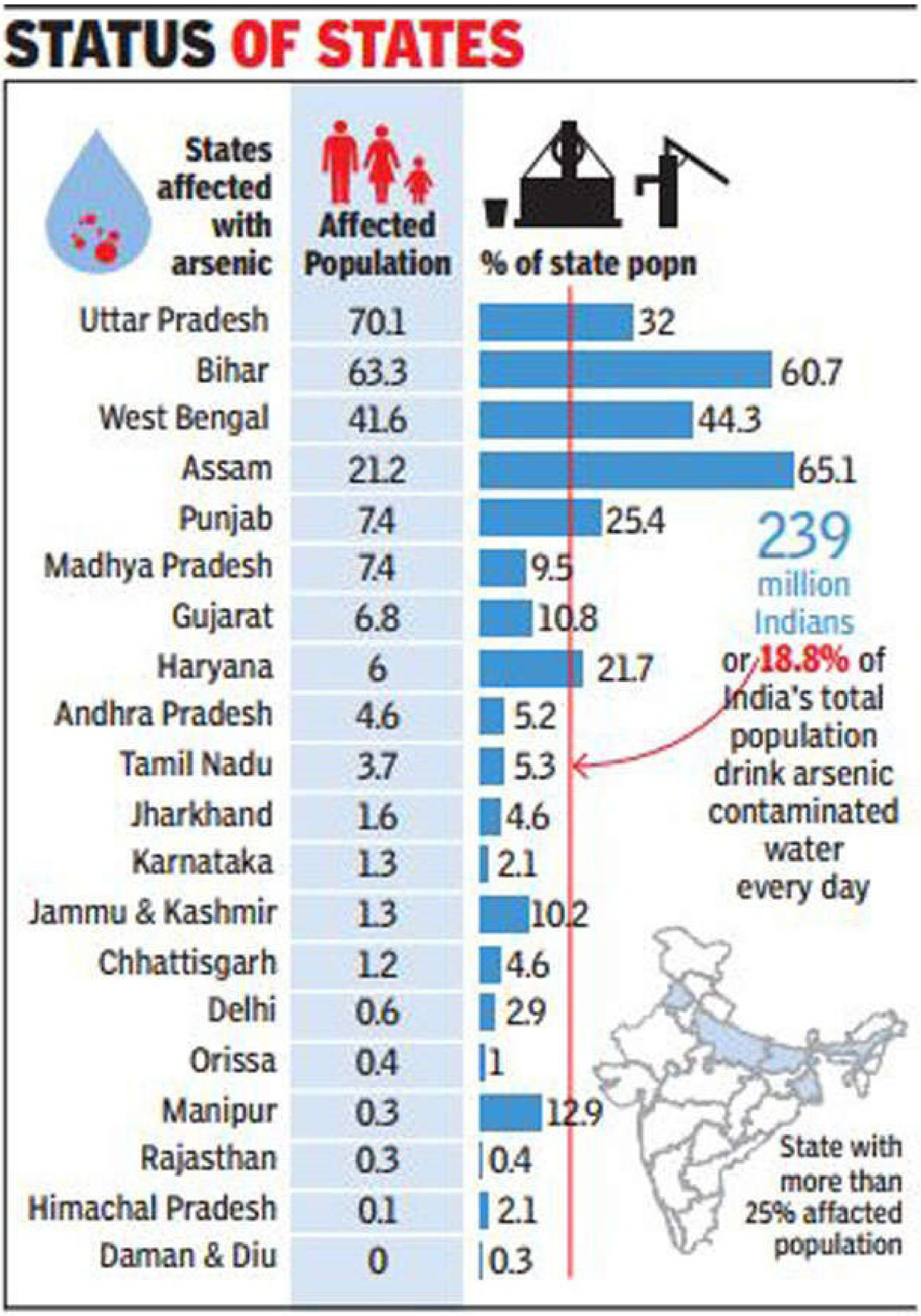
Surface Water. India has 12 major rivers, which cater for about 253 Million Hectare (mha) of catchment area and 46 medium rivers with 24.6 mha of the catchment area. Several of the river systems with their tributaries are perennial and some of them are seasonal. The Ganga-Brahmaputra-Meghna system is the most extensive river system in India, with 43 percent of the catchment area of all the major river systems.[16]

Groundwater. Groundwater is a replenishable resource. The primary source of groundwater is the recharge from monsoon precipitation, which is about 58 percent of the groundwater. Balance of 32 percent is contributed through seepage from canals, tanks, ponds and other water structures and irrigation. Rejuvenation of the minor rivers and village ponds, afforestation and statutory rainwater harvesting are some of the urgent measures to alleviate the problem of ever-shrinking water table. There is a need for better watershed management.

Need for De-silting. Rivers in North India are generally glacier-fed. A lot of silt is brought down by these rivers with them. This reduces the water carrying capacity of the river and also causes changing of the course. Regular de-silting of the main channel is required.

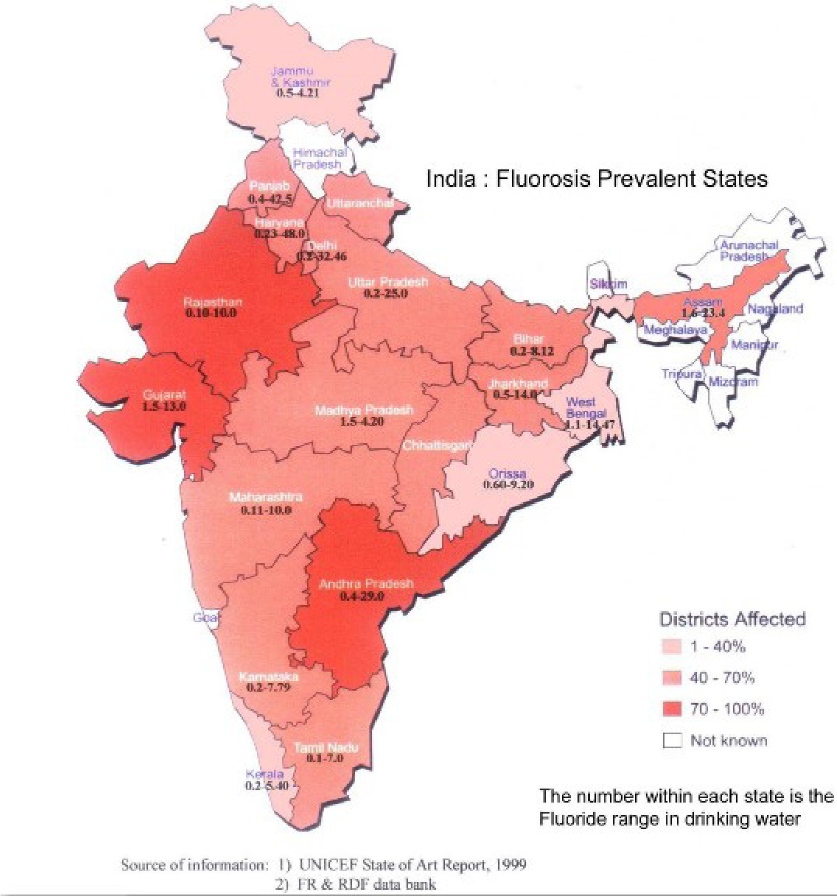
Water Contamination

Arsenic Contamination. Arsenic contamination of groundwater in the Ganga-Brahmaputra fluvial plains in India and Padma-Meghna fluvial plains in Bangladesh, and its consequences to human health have been reported as one of the world's most significant natural groundwater calamities to the humankind. Parts of Assam, Bihar, Uttar Pradesh, Chhattisgarh and West Bengal are suffering from contamination of arsenic in groundwater above the permissible limit of 10 µg/l due to soil chemistry.[17]



Source: https://timesofindia.indiatimes.com/india/19-of-indians-drink-water-with-lethal-levels-of-arsenic/articleshow/62226542.cms

Fluoride contamination. It is a well-known fact that Indian groundwater is polluted by fluoride. Rajasthan, Gujrat and Andhra Pradesh are worst affected.



Source: https://schools.indiawaterportal.org/wq-test/home?q=node/929

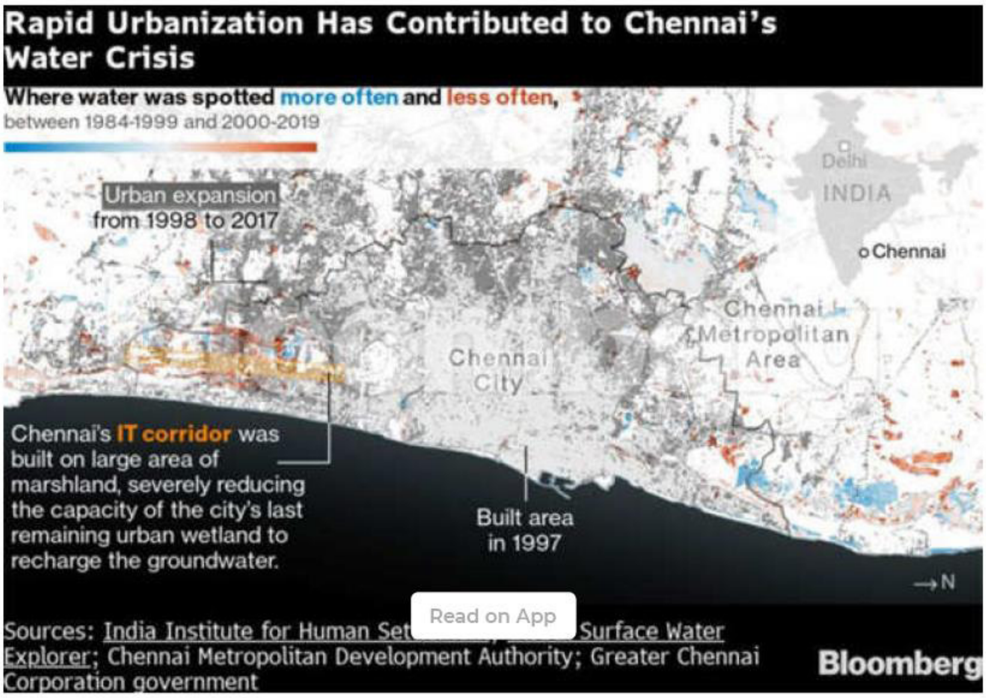
Case Study: Chennai's Day Zero

Chennai, India's sixth-largest city with the 11million inhabitants, gets an average of about 1,400mm (55 inches) of rainfall a year. It sits on a low plain on the southeast coast of India, crisscrossed by three heavily polluted main rivers that drain into the Bay of Bengal. Chennai is facing both rising sea levels and flooding. Cyclone-prone waters of the Bay of Bengal intermittently surge into the city, driving the sewage-filled rivers to overspill into the streets. Up to 90 percent rainfall is during the northeast monsoon season in November and December. If rains fail, the city has to rely on colossal desalination plants and water piped in from hundreds of km away because most of its rivers and lakes are too polluted. In 2019, Chennai hit the headlines as it had run out of water. It was bringing in 10 million litres a day by truck to hydrate its population. Ironically in that year, it had the wettest January in decades.[18]

The region once had an elegant system that date back 1,500 years. It had thousands of inter-connected gravity-fed reservoirs, called 'Erys'. During the monsoons, this chain of Erys captured the rainfall. If one got filled up, the water would flow to the next pond. This system began to decline after the British came and built over land that was once used for water management. Rather than a system of decentralised Erys, Chennai became reliant on a centralised water distribution system fed by four reservoirs. When 'Day Zero' was declared in 2019, the reservoirs were down to about one percent capacity.

The city earlier had 60 percent wetlands and 6,000 lakes and reservoirs that retained the 55 inches of rainfall each year, mostly in the monsoon season. Now, wetlands comprise only 27 percent of the city and 2,000 lakes in the state have disappeared. The wetlands and water bodies earlier retained the water for later use. When monsoon season hits, the rains lack a place to rest and so drain into the Bay of Bengal.

Chennai's water problems are increased by the city's rapid urbanisation, when the city opened its doors to technology companies. Automobile, healthcare, IT and film industries are thriving. As the city grew, huge areas of the surrounding floodplain, along with its lakes and ponds, disappeared. Between 1893 and 2017, the size of Chennai's water bodies shrank from 12.6 square km to about 3.2 square km. It's estimated that about a third of the city's population lives on the banks of the city's ponds and canals in informal settlements. As a result, human and other waste is dumped into the water. In the dry season, some canals basically hold only sewage.



Source: https://m.economictimes.com/news/politics-and-nation/how-chennai-one-of-the-worlds-wettest-major-cities-ran-out-of-water/amp_articleshow/8068018…

The signs are ominous. With fewer places to hold precipitation, flooding has been increasing. In 2015, Chennai underwent its worst flood in a century. The northeast monsoon in a single day put 494 mm (19.4 inches) of rain on the city. More than 400 people in the state died and 1.8 million had to move out of their homes. Water reached the second floor of some buildings in the IT corridor. Four years down the line, it was a shortage of water that made headlines. The city hit the 'Day Zero' as all its main lakes ran dry, forcing the Government to bring drinking water in trucks. People had to stand in queues for hours to fill containers, water tankers were hijacked, and violence erupted in some neighbourhoods.

The city has taken some action. It was the first state in India that passed a law as early as 2003 requiring all buildings to harvest rainwater. The rule helped raise the water table though there are complaints of a lack of maintenance. Efforts to recharge groundwater have also struggled to balance the volume of water being pulled out through boreholes.

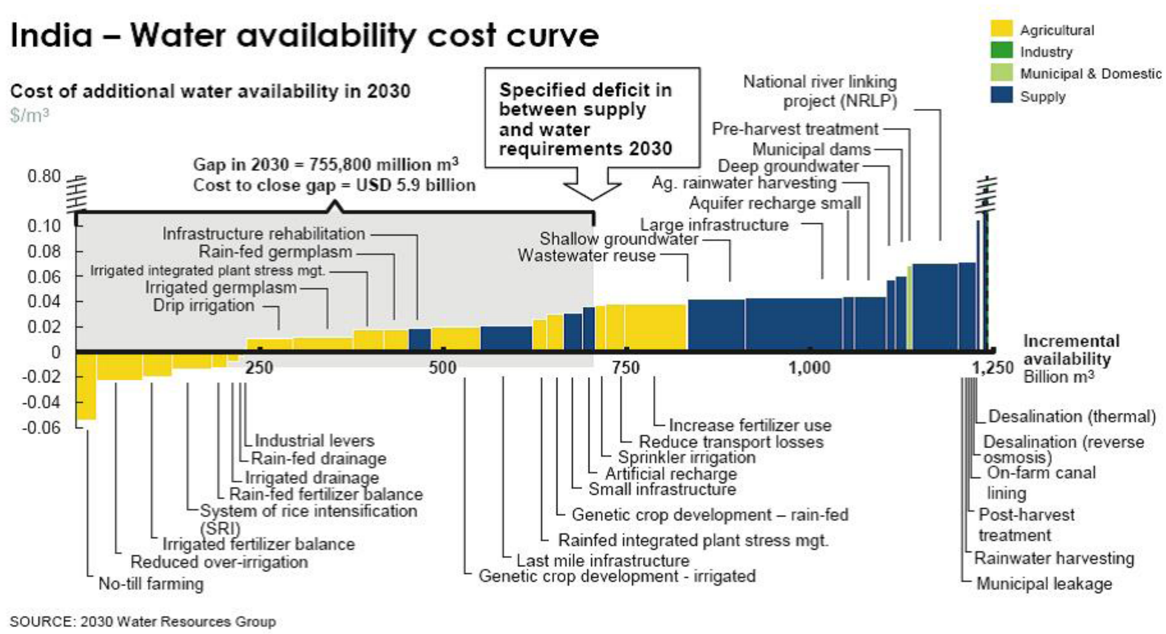
Tamil Nadu Chief Minister, shortly after 2019's Day Zero, announced a program that would include a "massive participation of women" covering the whole lot from rainwater harvesting, water-saving, recycling and protecting water resources. The Government now is supporting an initiative called 'City of 1,000 Tanks', a reference to the ancient artificial lakes that were built around temples. The plan is to reinstate some temple tanks and make hundreds of new ones with green slopes throughout the city to absorb and filter heavy rains, recharge the groundwater and store water for dry months.[19]

India's Water Woes

India is suffering from the worst water crisis in its history. Millions of lives and livelihoods are under threat. Critical groundwater resources, which account for 40 percent of our water supply, are being depleted at unsustainable rates. Droughts are becoming more frequent, creating severe problems for India's rain-dependent farmers. When water is available, it is expected to be polluted by up to 70 percent which can result in nearly 200,000 deaths each year. Inter-state disagreements are on the increase with seven major disputes currently raging. It shows that only limited frameworks and institutions are in place for national level water governance.

Presently, 600 million Indians face high to extreme water stress. Around two lakh people die each year due to inadequate access to safe water. The crisis is only going to get worse. The country's water demand, by 2030, is expected to be twice the available supply, indicating severe water scarcity and an eventual ~6 percent loss in the country's GDP. As per the National Commission for Integrated Water Resource Development of the Ministry of Water Resources (MoWR), our water requirement by 2050 is likely to be 1,180 BCM, whereas the present-day availability is 695 BCM. There is an immediate need to deepen our understanding of our water resources and usage, and put interventions that make our water use efficient and sustainable.

As per the report by 2030 Water Resources Group, India's path to water resource security lies in improving agriculture's water efficiency and productivity. If existing rain-fed and irrigated land are made more productive, additional land and irrigation would not be necessary. It would reduce the amount of water required. A number of actions can be taken to increase yields and make land more productive. Some of the measures are; improved drainage, no-till farming, optimised fertiliser use, utilisation of best available germplasm or other seed development, and the application of crop stress management including integrated pest management and innovative crop protection technologies.



Source: Charting Our Water Future, Economic frameworks to inform decision-making, 2030 Water Resources Group, 2009: https://www.mckinsey.com/~/media /mckinsey/ dotcom/ client_service/ sustainability/pdfs/charting_our_water_future_full_ report. ashx

Other significant agricultural opportunities are on investment in genetic crop development, improved irrigation control and drip irrigation.[20] Some key policy initiatives taken by the Government are[21]:-

- **Basin-level Governance.** The consolidation of several river authorities into the central Ministry of Water Resources enables better decision-making for surface water projects and allocation.

- **Groundwater Bill.** Drafting and discussion of a model groundwater bill that defines groundwater as being held 'in trust' by the Government and specifies a de-centralised structure for its governance.

- **Innovative Irrigation.** Renewed focus on micro-irrigation adoption by farmers in the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) to enable efficient on-farm water use.

- **Global Partnerships.** Formalisation of a partnership with Israel, the world leader in water governance and conservation, to leverage Israeli experience and knowledge for water conservation in India.

China – the Elephant in the Room

Water Monopoly

Known as the 'Water Tower of Asia', the Tibetan plateau is a rich repository of indispensable freshwater resources that are shared across Asia. Tibet is the source of 10 major Asian river systems flowing into ten countries, including many of the most densely populated nations in the world: China, India, Vietnam, Cambodia, Laos, Thailand, Burma, Bangladesh, Nepal, Bhutan, and Pakistan. China sees itself as an upstream controller of seven of South Asia's mightiest rivers – the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Yangtze and Mekong.[22] It is estimated that 718 billion cubic meters of surface water flow out of the Tibetan plateau. The Great Himalayan Watershed is home to thousands of glaciers and the source of Asia's greatest river systems, which are the lifeblood of nearly half the global population.

China is the greatest dam builder in the world. Over the last seven decades, the People's Republic of China has constructed more than 87,000 dams. These projects have led to the displacement of over 23 million people. After damming most of its rivers, China is now eyeing the major international rivers flowing out from the Tibetan plateau, signaling a new era of damming Tibet's rivers.

Soon after the Communist Party gained power, China's dam-building era began in the 1950s. It reached its peak in the past two decades. Currently, the Baihetan hydropower project, a 16 GW hydroelectric facility, is under construction on the Jinsha River in south-west China. After the Three Gorges Dam, it will be the second largest hydroelectric power plant in the world, Scheduled for commissioning in 2022, China will have completed five of the world's top 10 hydropower plants in just ten years. Since the turn of the century, China has more than quadrupled its installed capacity and accounted for over half of global hydropower growth. China's dam-building is expanding overseas too. Chinese hydro-companies invest heavily in other countries in South Asia, South East Asia, Africa and Latin America.[23] Central development banks have financed nearly $44 billion worth of hydropower projects worldwide since 2000.

Major rivers originating in Tibet.
Source: Council on Foreign Relations, 2016.

However, questions are being asked. Frank Yu, an analyst with Wood Mackenzie Ltd stated, "It's so cheap developing renewables and coal-fired power, why bother injecting huge sums of money to develop hydro 2,000 km deep into the Tibetan plateau. The future of hydro is going to be pumped storage and is also going to be smaller and smaller." Many analysts feel that getting materials and workers to such a remote area and construction of the power lines to get the electricity to consumers would be enormously costly.

China has complete upper riparian control over all major rivers flowing out of the Tibetan plateau. Despite the ecologically sensitive and seismically active nature of the Tibetan plateau, China is going ahead with its ambitious plan to expand the hydropower generation on the headwaters of Asia's major rivers — the Yangtze, Yellow, Brahmaputra, Indus, Mekong, and Salween Rivers.

China's Water Policy. China considers water a sovereign resource rather than a shared resource. This approach has an adverse effect on downstream countries. China treats data about water flow and hydropower operations as a state secret. Chinese specialists often say: Not one drop of China's water should be shared without China using it first or without making those downstream pay for it. China has not signed international treaties for most of its forty trans-boundary rivers.[24] In generally arid Central Asia, China has diverted waters from the Illy and Irtysh rivers, which originate in China-annexed Xinjiang.[25] Its diversion of water from the Illy threatens to turn Kazakhstan's Lake Balkhash into another Aral Sea, which has all but dried up in less than four decades.[26]

Example of Mekong River

As an upper riparian state in Asia, China has been blocking rivers like the Mekong and its tributaries, thus affecting Southeast Asian countries like Thailand, Vietnam, Laos and Cambodia. It has caused massive damage to the environment and altered river flows in the region. The smaller states are helpless in effectively resisting as they do not have significant leverage in negotiations.

When China built the first dam on the upper Mekong in the 1990s, there was apprehension that it would use its dams to restrict water from the Mekong downstream. There are eleven mega-dams in China's upper Mekong reaches. The frequency and severity of drought in downstream countries have increased over the last two decades. Thailand, Cambodia and Vietnam are currently suffering through the worst drought in their history.

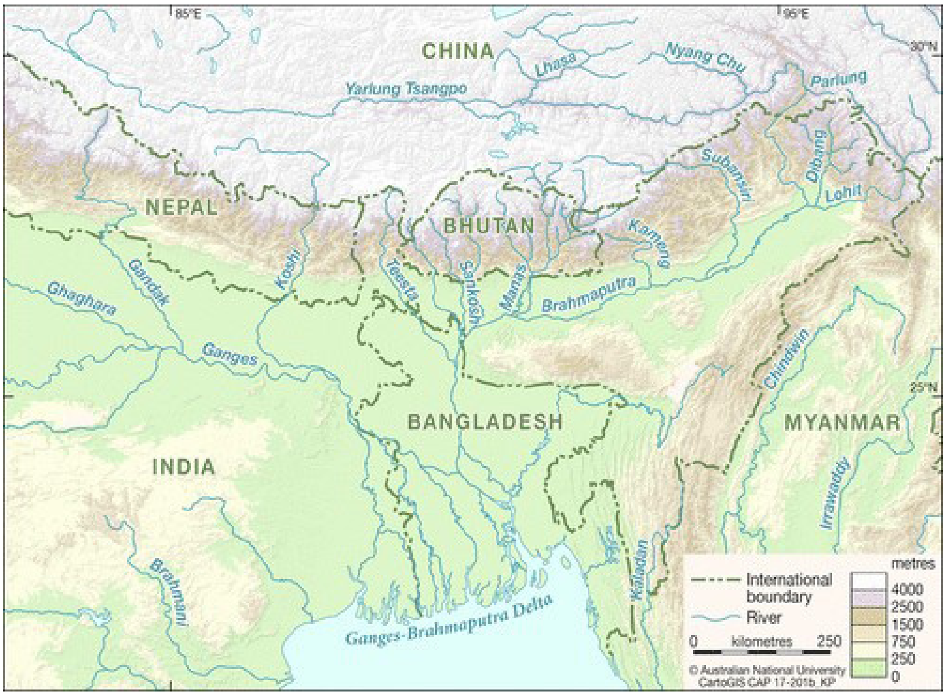
China's dam management is causing erratic and devastating changes in water levels downstream. Unexpected dam releases have caused rapid rises in river level that have devastated communities downstream, causing millions in damage, shocking the river's ecological processes. For six months in 2019, China's dams held back so much water that they entirely prevented the annual monsoon-driven rise in river level at Chiang Saen, Thailand. Recent data shows that in 2019, during a severe drought in the Lower Mekong Basin, China's upper basin enjoyed high rainfall and snowmelt. If China's dams did not restrict flow, portions of the Mekong along the Thai-Lao border would have experienced above-average flows from April 2019 instead of suffering through severe drought conditions. The increasing frequency of drought in the Lower Basin tracks closely how China restricts water upstream during the dry season.

Source: Stimson Centre

In July 2019, Thailand had to mobilise its military to manage the drought emergency in its northeast provinces.[27] In Cambodia, fishing communities from the world's largest inland fishery alongside the Tonle Sap reported fish catches 80-90 percent lower than usual.[28] Now some highly populated areas of Vietnam's Mekong Delta have completely lost access to fresh water.[29] During the 2019 June to October monsoon season, the regional and international media reported record low river levels throughout the lower Mekong countries.[30]

Brahmaputra / Yarlung Tsangpo

The Brahmaputra known as Yarlung Tsangpo in Tibet is the largest and most important river coming out of Tibetan plateau. The Brahmaputra, is shared between Tibet, India, and Bangladesh. It stretches over a total length of 1,800 miles (2,900 km) from west to east, starting on the Tibetan plateau from its source, the Chemayungdung glaciers near the sacred Mount Kailash.



The Brahmaputra (Yarlung Tsangpo) River basin.
Source: https://www.internationalrivers.org/campaigns/brahmaputra-yarlung-tsangpo

The river flows for about 1,625 km in Tibet, parallel to the main range of the Himalayas, before entering India in Arunachal Pradesh. The Siang flows down the Himalayas, enters the Assam valley, joins two other major tributaries, Dibang and Lohit and becomes the mighty Brahmaputra. It carries more water than Europe's 20 largest rivers combined. It is the focus of recent Chinese dam-building projects. The river flows for about 2,900 km through Tibet, India and Bangladesh into the Bay of Bengal. Before crossing into India, the Brahmaputra curves sharply around the Himalayas called the Great Bend leaving the Tibetan Plateau. It formed the world's longest and steepest canyon, twice as deep as America's Grand Canyon. The Brahmaputra holds Asia's largest untapped water resources.

Source: Google image

China's Dam building on Yarlung Tsangpo

Diversion of Water Flow

China is building five dams on the Brahmaputra river.[31] Chinese hydropower and energy companies have been lobbying the government to allow more hydropower projects to tap into Tibet's fast-flowing rivers. 28 proposals [32] are awaiting approval. The 510 MW Zangmu Hydropower Station costing $1.5 billion, the largest in Tibet, was operationalised in 2015. When the Zam dam started functioning, Zhang Boting, the deputy secretary-general of the China Society for Hydropower Engineering and an influential pro-hydropower advisory group, described the Brahmaputra as the country's 'last great energy hope'. The mainstream flow of the Brahmaputra has the richest water resources in Tibet, about 80 million kWh of power. He said, referring to the 22.5-GW mega-dam China built on the Yangtze "This river alone has the power for two Three Gorges dams."

The 360 MW Jiacha dam is ready to be commissioned. Two more dams, the Dagu and the Jiexu, are in progress. Rated at 640 MW, the Dagu will be the biggest of the four. All the dams are located in eastern Tibet, not far from Arunachal Pradesh. The Lolha dam on the Xiabuqu river, a tributary of the Brahmaputra, has also been completed. In recent years there has been speculation on the commissioning of this sixth project, referred to as Medog hydropower station located in south-east Tibet. The hydropower station in Medog will come up just 30 km away from the Indian border inside a giant canyon of the Brahmaputra. The canyon is the bent of the Brahmaputra river and is about 320 km long and almost five km wide.

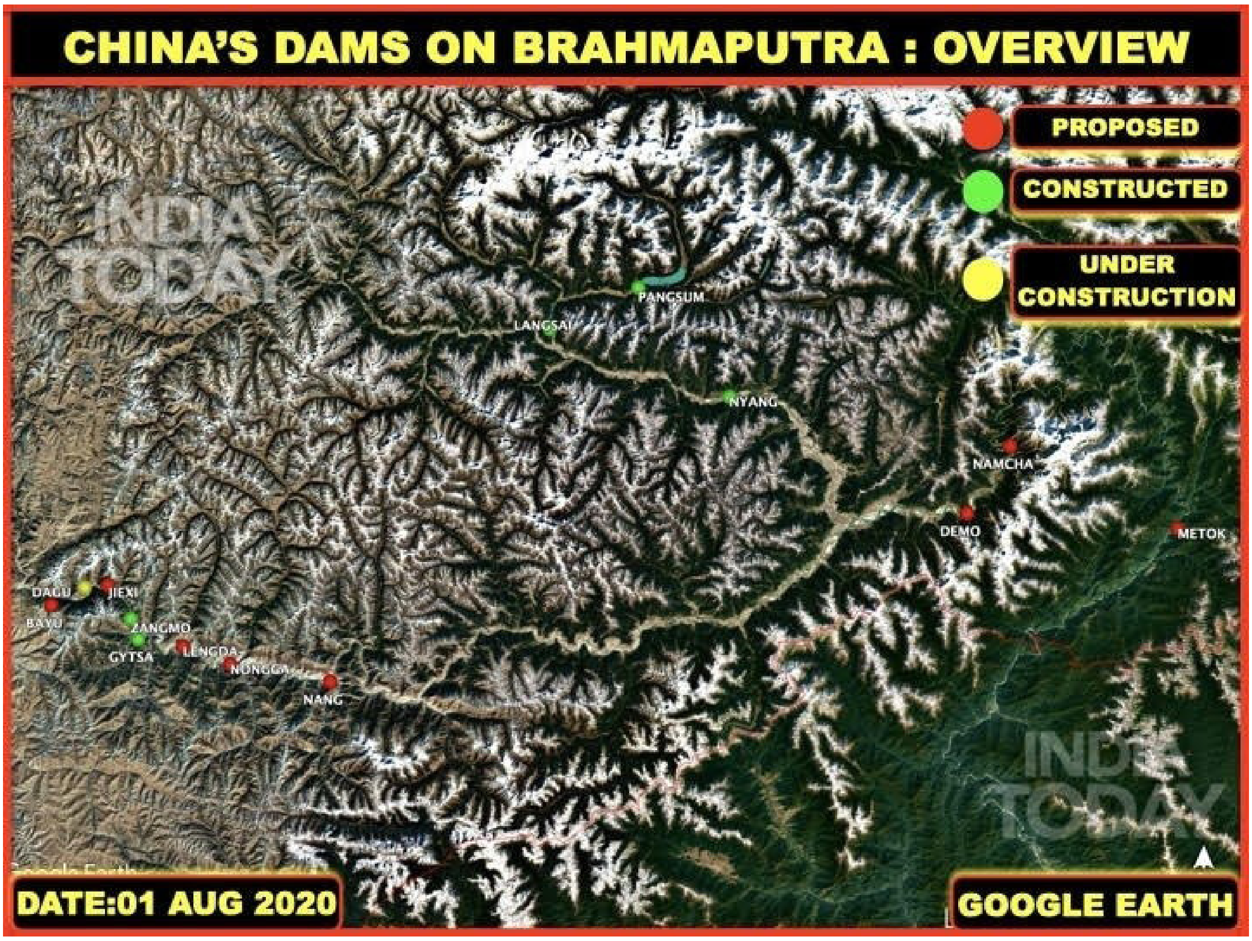
28 dams have been proposed on Tibet's rivers, though not all of them are likely to be built.

Zangmo, Gyatsa, and Dagu. There are three dams on the main Brahmaputra River built in unusually close proximity to each other. These dams are located within a very short distance of 24 km. While the Zangmo dam has been commissioned, the Gyatsa dam is complete and awaiting commissioning. The third and largest of the trio, the Dagu dam has been under construction since 2017.

The proposed dams on the Yarlung Tsangpo River in Tibet are close to the Indian border in Arunachal Pradesh. Here, the Chinese constructed three dams within 24 km on the

Brahmaputra River over ten years. With only the single village of Gyatsa and its population of barely 150 households, three dams are unprecedented. Construction of these dams at an extraordinary pace and scale has taken place in Tibet's Sangri Lokha. Construction of a similar 'triplet dam' has been observed on the tributary called Nyang that feeds the Brahmaputra River. It is near the town of Nyingchi in Tibet's Nyingchi county. Lokha, also known as Shanan lies in the northeast of Bhutan and south of Lhasa, while Nyingchi is further east, bordering Arunachal Pradesh. The dams at Pagsum, Langsai and Nyang are much smaller in size but hold enough water to add to the Brahmaputra River flow.

China has proposed to build at least eight more dams on the Brahmaputra River in Tibet. These dams are to be built within the next 10 years at Bayu, Jiexi, Langta, Dakpa, Nang, Demo, Namcha and Metok towns that do not have more than a hundred households each. This indicates that these dams are to build reservoirs and export electric energy from Tibet to mainland China.



Source: https://www.indiatoday.in/india/story/china-s-dams-in-tibet-may-pose-threat-to-india-s-water-supply-satellite-images-explain-1709475

Huaneng Tibet Power Generation Co. Ltd. (HTPG), a subsidiary of the state-owned China Huaneng Group, has signed multiple agreements with the Tibet Autonomous Region (TAR) government on clean energy development in the region. According to the agreements between the company and the regional government, Huaneng's installed capacity in Tibet is expected to reach 10,000 megawatts by 2020. It is believed that hydropower resources in the TAR account for 29 per cent of the national total. According to the plan, Huaneng Group is responsible for developing the Jiexu and Jiacha hydropower stations, whereas the Huadian group is constructing the Dagu dam. This is the second large hydropower dam after the Zangmu to be built on the mainstream of the Yarlung Tsangpo. The Jiacha (Gacha) Hydropower Station is located in Gyatsa county of Tibet on the middle reaches of the Yarlung Tsangpo.

Jiacha Dam. Photo: China Society for Hydropower Engineering (CSHE)

According to the China Society for Hydropower Engineering, Tibet's Jiacha Hydropower Station was successfully gated to store water. The installation and commissioning of the generator are in place and fully functioning. The 100-meter-level gravity dam has three units and their cumulative installed capacity will reach 360 megawatts. It is expected that the annual power generation will be 1.704 billion kilowatt-hours. Construction of Jiacha Dam began in December 2015 by Huaneng Tibet Power Generation Company Ltd (HTPG), a state-owned China Huaneng Group subsidiary.

There are diverse opinions about the exact number of dams that China has built in the Brahmaputra basin in Tibet. Some non-governmental organisations (NGOs) have asserted that 35 dams are now coming up in Tibet over the Brahmaputra river, eight on the mainstream of the river and 27 more on its tributaries. Another school of opinion is that China will build 20 dams on the Brahmaputra itself. China has never come clean on the exact number of dams it intends to build. It always promised that those would be run-of-the-river types and there will be no blocking the water flow of the mighty river. However, even run-of-the-river type projects require dams and therefore lessening of the river water flow is a plain reality.[33]

Latest Project of the Mega Dam

The Yarlung Tsangpo Downstream Hydropower Base has now been listed in China's new five-year plan as one of the country's major energy development projects for the 2021-2025 period.[34] The super hydropower station will be constructed in Medog, on the Brahmaputra's Great Bend bordering Arunachal Pradesh, 30 km from the Indian border. The plans first appeared in the Chinese Communist Party's proposal for the 14th Five Year Plan and the long-term vision for 2035 in early November, 2020. The proposal did not give many details.[35] Development of nearly 60 million kilowatts or 60 GW of hydropower can provide nearly 300 billion kWh per year, offering a glimpse into the huge scale of the project.[36]

The National People's Congress (NPC), China's legislature with over 2,000 members, Attended by Chinese President Xi Jinping, Premier Li Keqiang and other senior leaders on March 11, 2021, approved the 14th Five-Year Plan (2021-2025) for national economic and social development and the long-range objectives through the year 2035. Che Dalha, deputy Communist Party chief of the TAR, said during the NPC session that authorities should "strive to begin construction of the dam this year. Comprehensive planning and environmental impact assessments for the project should be approved as soon as possible". Che also said that the exploration of natural gas in northern Tibet should be one of the focuses of the country's energy development goals over the next five years.

The plan was first revealed in late 2020 by Yan Zhiyong, chairman of the Power Construction Corp of China or 'Powerchina'. At a conference to celebrate the 40th anniversary of the founding of the China Society for Hydropower Engineering Yan said, "There is no parallel in history…it will be a historic opportunity for the Chinese hydropower industry." In his conference speech, company president Yan Zhiyong said Powerchina would be the project contractor and ensure its execution. The project could play a significant role in helping China reach its goal of achieving peak carbon emissions before 2030 and carbon neutrality by 2060 and bringing money and development to the Tibet Autonomous Region.

Commenting on the proposal to build the dam, Chinese foreign ministry spokesperson Hua Chunying told a media briefing in Beijing on December 3 last year that the "hydropower development in the lower reaches of Yarlung Zangbo River is China's legitimate right. When it comes to the use and development of cross border rivers, China always acts responsibly…We have a policy featuring development and conservation. All projects will go through science-based planning and assessment, giving full consideration to impact downstream and accommodating the interests of upstream and upstream-downstream regions. The development of the lower reaches of Yarlung Zangbo is in the early stages of planning and assessment. There is no need to read too much into that."[37]

China's State Council's energy plan for the 12th Five-Year Plan (2011-15) and 13th Five-Year Plan (2016-2020) confirm the government's intentions to push forward the hydropower project on the Tibetan plateau vigorously. Hydropower is being promoted as the centre piece of China's plan to expand its renewable energy sector. By 2020, China wants to triple its hydropower capacity to 300 GW. Therefore, it is increasingly damming trans-boundary rivers to achieve its hydropower targets. As per the Global Times, Chairman of the Power Construction Corp of China, Yan Zhiyong, said that China will "implement hydropower exploitation downstream of the Yarlung Zangbo River", and the project could serve to maintain water resources and domestic security.

Effects of the Mega Dam

Impacts of climate change are already acute in Tibet, known as the roof of the world. Emerging dangers like climate change, landslides, extreme events, forest fires and many other ecological threats pose new challenges. The glaciers and snowlines of the Himalayas are retreating. If this trend continues, the waterways of the Tibetan Plateau could first flood and then dry up, turning the land into a desert.

There is no doubt that the project is dangerous from an environmental point of view. The ecosystem of the gorge region called the Great Bend and where this mega-dam is planned, is already in decline. The primary forests are disappearing, leading to a rapid spread of soil erosion and landslides. Chinese hydropower projects, as stated earlier, are located in an area which is very close to the geological fault line where the Indian Plate collides with the Eurasian Plate. All these hydropower plants will have to constantly live under the possibility of earthquakes. An adverse natural event causing major damage to Tibet's dams could lead to floods downstream in India. Example of an earthquake measuring 7.9 on the Richter Scale, devastating the Three Gorges Dam on the Yangtze river, is a stark reality.

The world's highest altitude river, the Brahmaputra, gathers extremely rich silt, which provides essential nutrients for the soil and farming downstream. High silt loads are a feature of Tibet's rivers. It is central to the river's unique hydrology and biodiversity support and is essential to maintain the agricultural soil fertility downstream. China's dam-building will upset the Brahmaputra's annual flooding cycle, causing a deterioration in India's and Bangladesh's food security and human habitats. This is likely to cause subsidence and salinity in the Brahmaputra-Ganges-Meghna delta. Experts have warned that the combined dam plans of China and India could have disastrous ecological consequences in one of the world's most fragile regions.[38]

China has never communicated officially about the construction of these dams on the Brahmaputra. A lack of transparency about dam building on the Tibetan river raises questions about whether the Tibetan people and the downstream countries were fully informed about the risk and impacts on a river system that supports millions. China will be responsible for the overexploitation of the river, which can jeopardise the river ecosystem as well as alter water flows downstream.[39]

Threats from the Mega Dam

From past experiences, it can be concluded that the proposed megaproject threatens China's downstream neighbours. China's past upstream activities have triggered flash floods in the states of Arunachal and Himachal. Recently, such activity turned the water in the Brahmaputra's main artery, the unspoiled Siang river dirty, and grey as it entered India.[40] Though about a dozen small or medium-sized Chinese dams are now operational in the Brahmaputra's upper reaches, this mega-dam will enable China to manipulate trans-boundary flows far more effectively. China has already blocked the flow of one of Brahmaputra's Tibetan tributaries, the Xiabuqu river, for the Lalho hydel project.[41] During the border clashes between India and China in the Galwan Valley from May 2020, China choked the flow of the Galwan River, a tributary of the Indus originating in the Chinese-controlled Aksai Chin area.[42] The risks are acute.

Satellite images clearly show that the area where dams are constructed is sparsely populated. Electricity demands in the region could be met with a single hydroelectricity project like the Zangmo dam. China is not building such large number of dams on the Brahmaputra River to benefit the people of Tibet. The Chinese aim could be to use these dam reservoirs, such as the Dagu dam, to divert Brahmaputra's water to dry areas in Xinjiang or Central China though there is no direct evidence yet of such diversions. China's storing water in eleven dams on the Brahmaputra River is a cause of great concern for India. It could control the water flowing into India. Low lying areas in India will be completely inundated if China suddenly releases all this stored up water. Also, blocking India's water supply even for a few days can lead to rivers drying up across the country.

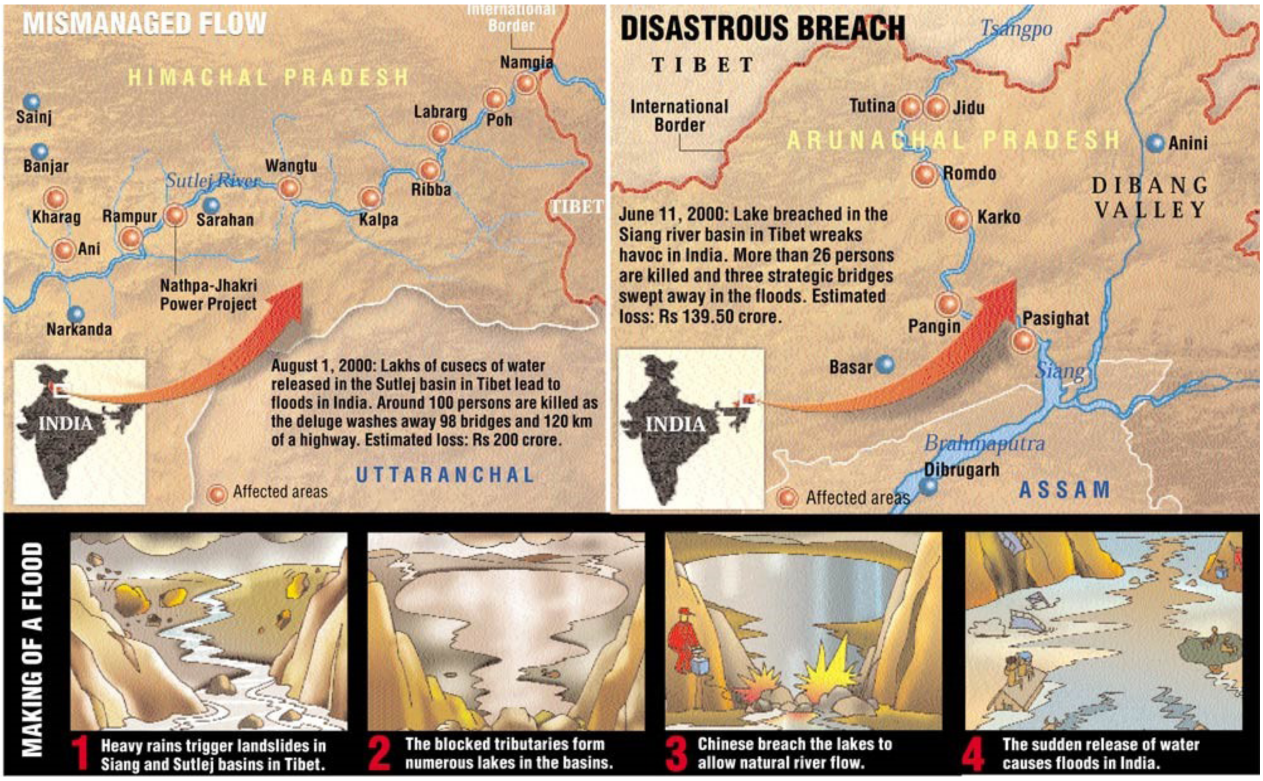
The most adversely affected country as a result of China's Brahmaputra dam project will be densely populated and China-friendly Bangladesh.[43] The Brahmaputra is the single largest freshwater source for Bangladesh. Disruption of its water supply will most likely trigger an exodus of refugees to India. This may become a major national security issue as India is already home to millions of illegally settled Bangladeshis.

Examples of Deliberate Flooding

The Sutlej is part of the Indus river system and enters India from Tibet in the Kinnaur district of Himachal Pradesh. At 1.30 a.m. on August 1, 2000, a 50-ft high wall of water tore into Pari Chu (river), which was carried into Sutlej river from Khab on the border of Himachal Pradesh Tibet. The mountain gorges of Kinnaur, Shimla and Mandi districts in Himachal Pradesh washed away everything that came in its path. By 0515 hours, it reached Nathpa Jhakri Project (NJP). Within a short time, the level of river Sutlej rose by 15 metres. There was no flood in river Spiti, which joins river Sutlej near Khab. More than 100 persons lost their lives, 120 km of the strategic Old Hindustan-Tibet Highway was washed away and 98 bridges of various sizes and shapes were completely destroyed.

This was a replay of the flash floods in Arunachal Pradesh about two months earlier, on June 11. Only this time, the river that ravaged the Indian countryside was the Brahmaputra in Assam. That day, the Siang river rose by an unprecedented 100-120 ft in the border state and devastated four districts of Arunachal Pradesh. More than 26 persons lost their lives while three strategic bridges were swept away by the raging river waters.

The Indian Space Research Organisation (ISRO) had solid evidence that the Chinese caused the flash floods which ravaged large tracts in the border states of Himachal Pradesh and Arunachal Pradesh. A detailed study by ISRO scientists said the release of excess water accumulated in man-made and natural water bodies in the Sutlej and the Siang river basins in Tibet led to the flooding. Satellite images showed massive water bodies or lakes upstream in Sutlej and Siang river basins before the flash floods took place. These lakes disappeared soon after the disaster struck Indian territory. This probably means that the Chinese had breached these water bodies as a result of which lakhs of cusecs of water were released into the Sutlej and Siang river basins.[44]



Source: Shishir Gupta, Floods ravage Himachal and Arunachal Pradesh, satellite pictures suggest China's hand, India Today, June 25, 2001 available at: https://www.indiatoday.in/magazine/neighbours/story/20010625-floods-ravage-himachal-and-arunachal-pradesh-satellite-pictures-suggest-china-hand-774997-2001-06-25#

In 2004, a lake began to form on the Pari Chu, a tributary of the Sutlej threatening to cause floods to lower down in India's Sutlej valley. While China remained cooperative and shared upstream data in advance with India at that time, there was speculation that China deliberately created a 'a liquid bomb', an artificial lake, to be unleashed at will to potentially devastate downstream areas. This possibility got credence as China rejected a request by India to send scientists and engineers to the site[45,46].

In 2017, the Siang river, which joins the Lohit and the Dibang rivers downstream to form the Brahmaputra, turned muddy and blackened, raising concerns about China's upstream activities.[47] With up to ten inches of sediment accumulated on some stretches of the riverbed, the water became unfit for human consumption. This incidence adversely affected agriculture production in the Siang valley, known as one of the rice bowls of Arunachal Pradesh; it also had a detrimental impact on fishing communities.[48] While China stated that an earthquake in November 2017 might have been the cause, the river waters reportedly had changed before the quake struck.[49]

The Brahmaputra, on March 1, 2012, had run completely dry at a place called Pasighat in Arunachal Pradesh. This was unprecedented. After a few hours, the Brahmaputra was filled up with high columns of onrushing water to inundate the Pasighat town. This incidence raises the possibility of blocking of water at upper reaches first and its sudden release after that.[50] Around October and November of 2018, there was a report that China had clamped down on the Brahmaputra river and water flow had almost come to a halt. Water was unusually muddy at that time.[51]

Huanqiu Shibao, a Chinese communist publication, citing an article that appeared in Australia, recently urged India's government to assess how China could 'weaponize' its control over trans-boundary waters and potentially 'choke' the Indian economy. [52] [53] China has provided that answer with its Brahmaputra megaproject.

Effects on Flow of Water in the Brahmaputra

There are different opinions about the impact of the proposed dams near the Great Bend. A gigantic hydropower project will undoubtedly have some effects on the quantity of water flow in the Brahmaputra. There is one school of thought which believes that the negative impact may not be huge. The Brahmaputra receives most of its water supply from massive rains in the catchment areas of its tributaries, mainly from Lohit and Subansari rivers. When the Brahmaputra reaches the Assam valley, the Siang contributes about 30 per cent of the Brahmaputra water. Other rivers like Kameng, Manas, Sankosh etc., also contribute so that the Brahmaputra carries eight times more water as it exits the country to Bangladesh than when the Siang enters Arunachal Pradesh.

Pranab Kumar Roy, director of Kolkata-based Center for Hydro Meteorological Research, has opined that only about 4 per cent of the Brahmaputra water is utilisable due to flow rate and sheer volume of the river. So around a 10 to 20 per cent shortfall in the river's upper reaches will not affect the total availability of water on the Indian side.[54] There is a major flaw in this argument. The average is calculated by including the monsoon seasons when all the rivers are full. What happens in the lean season? Fluvial eco-systems depend on perennial water sources. If there is no water flow from Siang are we looking towards a largely dry river bed of the mighty Brahmaputra during this time?

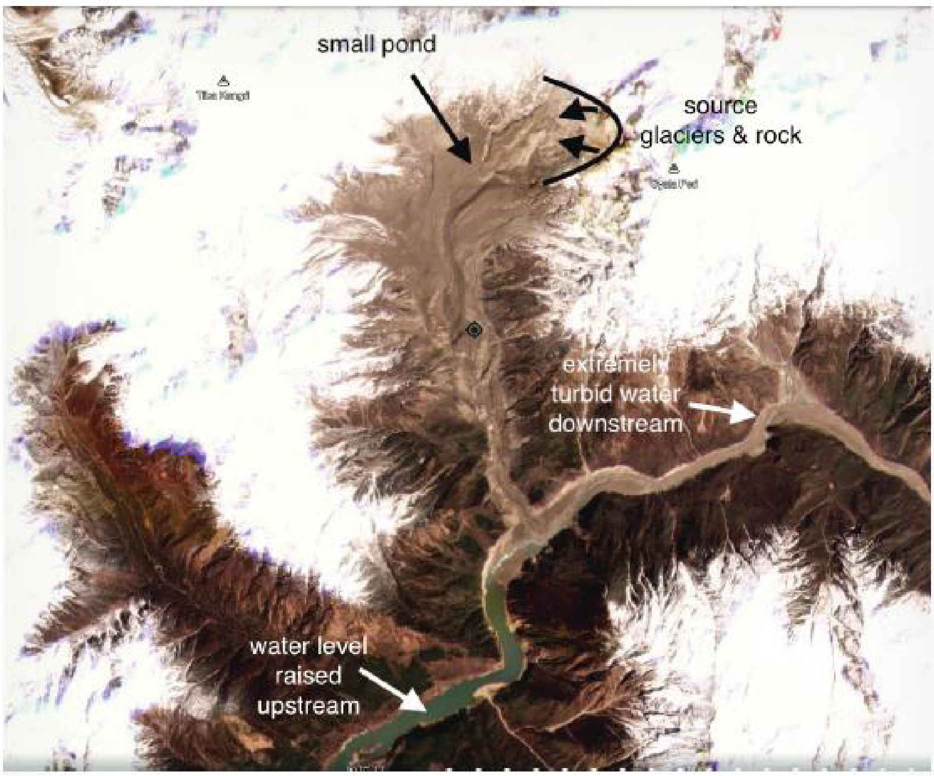
Bilateral Memorandums of Understanding.

India and China established Expert Level Mechanism (ELM) in 2006 to discuss various trans-border rivers. India and China have signed two pacts since 2008 on data sharing for the Sutlej and Brahmaputra to better manage the shared watercourses. [55] Under the existing bilateral memorandums of understanding, China provides India hydrological information on Brahmaputra and Sutlej rivers during the flood seasons so that India can keep track of water levels and prepare for floods. Though these agreements have positively affected water management and helped pre-empt and control flooding, this dependence can also be exploited by withholding hydrological data accessible only to the upper riparian state. China has access to valuable data that can help manage floods and fluctuations downstream.

For instance, in 2017, there were reports that China, in contravention of the agreement, withheld hydrological data for the Brahmaputra and Sutlej rivers resulting in floods. [56] This wasn't the only time that shared waterways in the area caused alarm. During the 2018 Doklam border standoff, China stopped communication of water flow levels from its dams, effectively rendering India blind to floods during the standoff.[57]

Pointer for the Future

There was a massive landslide, possibly on March 22, 2021, at about 50 km downstream of the projected giga-hydropower plant (HPP) on the Yarlung Tsangpo River. The landslide briefly blocked the flow of Yarlung Tsangpo. It started flowing again and is now reportedly flowing freely. It is not clear whether it was triggered by any earthquake. The nearest large earthquake in terms of space and time was the March 19, 2021 earthquake of 5.7 magnitude located at 31.906°N 92.899°E, its distance being 10 km away from the landslide location and the possible landslide date.[58]



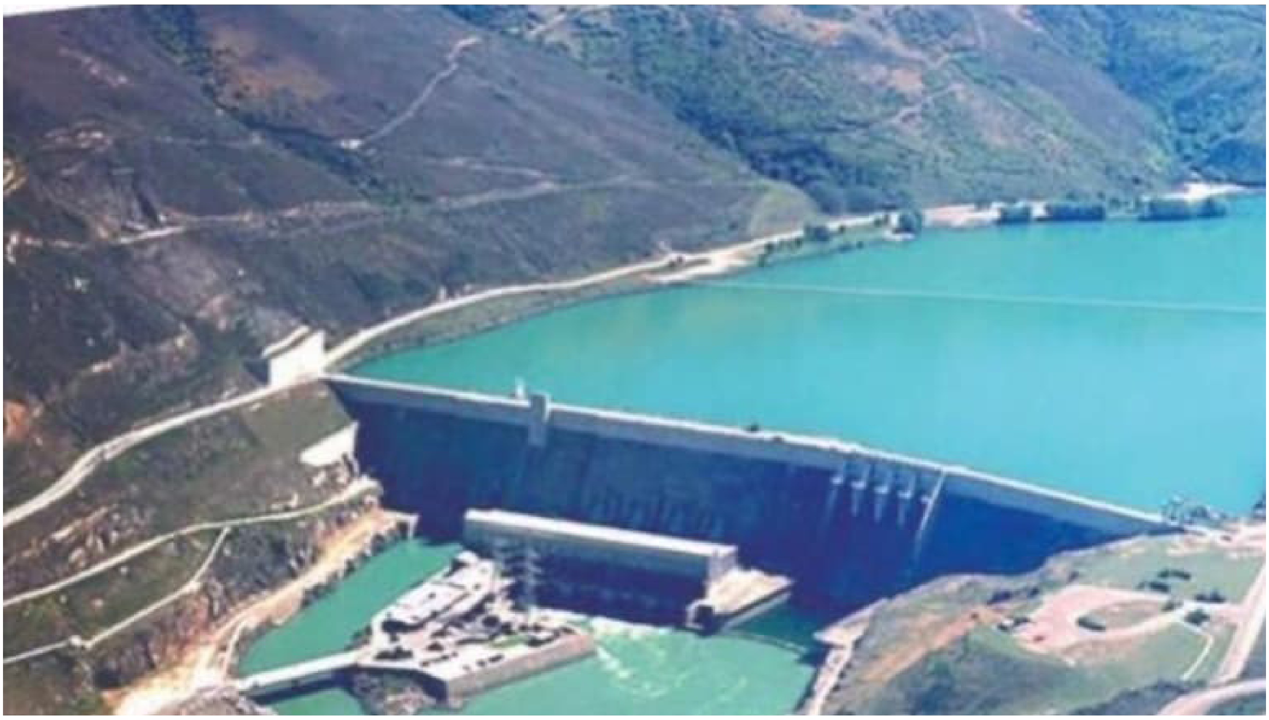
Source: https://sandrp.in/2021/03/30/massive-landslide-on-yarlung-tsangpo-on-march-22-2021/#more-41169

The volume of flow was 'detached from the east side of the tributary valley to move westwards and then to the south'. Once again this formed a catastrophic channelised flow that travelled down the channel to deposit a large volume in the main channel. The huge increase in turbidity of the water downstream of the blockage on the Yarlung Tsangpo made it one of the most dynamic landslide locations on Earth."[59]

Effects in the Pak Occupied Kashmir(PoK)

China's effort to use river water as a strategic weapon is not restricted to the Brahmaputra system. It is also deeply embedded in the Indus river system in the west.

An additional five dams are being financed and built by China in the Indus River Basin in the Pakistan Occupied Kashmir (PoK). The Diamer-Bhasha damon the Indus river is a bone of contention for India.[60] It is being built in the Gilgit-Baltistan region, a territory of Ladakh but under Pakistan's occupation since 1947. China has signed a MoU with Pakistan for the construction of this dam. It is an agreement between the Chinese state-run firm China Power and the Pakistan Army's construction wing Frontier Works Organisation. The dam will be completed by 2028.



Source: https://www.indiatoday.in/news-analysis/story/rising-stake-of-china-in-pakistan-occupied-kashmir-1701211-2020-07-16

Another big dam being built on the Indus river in the region is the Bunji dam Reports suggest China has deployed here its team that made the Three Gorges dam.

Conclusion

China is undertaking large-scale infrastructure projects such as the South-North Water Diversion Project and West-East Power Transfer Project. To meet its irrigation and power needs, as per the Five-Year Plan 2011–15, the Chinese government plans to build 120 gigawatts of new hydropower plants on the Salween, the Upper Mekong, Upper Yangtze and the Brahmaputra – "more than one new Three Gorges Dam every year for the next five years, and … more than any other country has built in its entire history."

One probable reason for China to undertake such massive projects is the commitment given by Xi Jinping on controlling carbon emission in the Paris Accord. The only way China can satisfy its colossal energy needs and replace thermal power is by tapping on hydroelectric power. Also, with the headwinds suffered by Belt and Road Initiative (BRI), China needs to employ its workforce and utilise its state-owned enterprise (SOE) for infrastructure development.

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