Implications of China's Hydro-Hegemony on River Yarlung Tsangpo: Another Lever of China's Expansionist Tactics into India's East

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Implications of China's Hydro-Hegemony on River Yarlung Tsangpo: Another Lever of China's Expansionist Tactics into India's East

Introduction

On 11 March 2021, China's parliament, the National People's Congress, endorsed a plan to build a 'super dam' on the lower reaches of the Yarlung Tsangpo River in southeastern Tibet. According to Chinese media reports, the dam will have an installed capacity of around 60 Gigawatt (GW), the world's largest, and will be built at The Great Bend section of the Yarlung Tsangpo River in Nyingchi Prefecture's Medog County close to the Indian border.

The plan has elicited serious concerns in India as it could adversely impact the flow of water in the Brahmaputra River (as the Yarlung Tsangpo is known in the country). This paper argues that China's planned construction of dams at The Great Bend and other sections of the Yarlung Tsangpo River are a manifestation of the country's negative/dominative form of hydro-hegemony and its potential implications for India are understood primarily in hydrological terms. There are fears that the dams may withhold, block or restrict water during the dry seasons leading to reduced water flow in the Brahmaputra River in India. Conversely, excess

water released from their reservoir during the wet season may trigger deadly floods in the country.

Chinese dams on the Yarlung Tsangpo River also have potential strategic implications - it could help China consolidate its position along the disputed Sino-Indian border. However, this have received far less attention and remained poorly understood. This paper contends that China's construction of dams on the Yarlung Tsangpo River, especially on its lower reaches including at The Great Bend section, are an integral part of the country's assertive infrastructure-driven policy aimed at consolidating its claims over disputed territories such as Arunachal Pradesh. It is therefore imperative that India take cognizance of the potential hydrological as well as strategic implications of Chinese dams on the Yarlung Tsangpo River and bolster its efforts to mitigate their impacts.

China, Asia's Pre-Eminent Hydro-Hegemon

China is Asia's pre-eminent hydro-hegemon by virtue of its riparian position, economic and military power, and its enormous potential for exploitation of water resource. The country is the source of a number of key trans-boundary rivers, much of which originated in the Tibetan Plateau in southwest China. The Tibetan Plateau is the highest and biggest plateau on Earth. Known as the "roof of the world," it covers about 2.5 million square kilometers and has an average elevation of roughly 4,500 meters (14,763 feet) above sea level. The plateau contains an estimated 46,000 glaciers or 14.5 percent of the global total, the largest reservoir of glaciers in the world after the Arctic and the Antarctic.[2] As a result, it is often referred as the 'Third Pole'.

These glaciers serve as the headwaters for many of Asia's largest rivers including Amu Darya, Brahmaputra (Yarlung Tsangpo), Ganges, Indus, Irrawaddy, Mekong, Salween, Tarim, Yangtze, and Yellow. Of these, Amu Darya, Brahmaputra, Ganges, Indus, Irrawaddy, Mekong, Salween, and

Tarim are trans-boundary or international rivers because they cross the political boundaries of two or more countries. The Yangtze and Yellow rivers on the other hand are located inside China. An estimated 1.6 billion people in Asia depended directly on these rivers for drinking water, agriculture, hydropower, and livelihoods. The Tibetan Plateau can therefore be considered the hydrological heart of Asia and China an upstream superpower[3] or an upstream water controller.[4] In describing the importance of rivers that originated from Tibet to the geopolitics of Asia, Peter Gleick, co-founder and president of the Pacific Institute in California, USA, and one of the world's foremost authorities on trans-boundary river issues observed that "The water of Tibet may prove to be one of its most important resources in the long run – for China, and for much of southern Asia. Figuring out how to sustainably manage that water will be a key to reducing political conflicts and tensions in the region."[5]

Source: Albert, Eleanor. 2016.[6]

A good indicator of the significance of water originating from China and the country's commanding position over the water resources of Asia is the water dependency ratio. According to the Food and Agriculture Organization (FAO), water dependency ratio is an "indicator expressing the percent of total renewable water resources originating outside the country."[7] The FAO explained that the indicator "may theoretically vary

between 0 per cent and 100 per cent." A country with a dependency ratio equal to 0 per cent does not receive any water from neighbouring countries. In other words, it is self-reliant in water resources. Conversely, a country with a dependency ratio equal to 100 per cent receives all its renewable water from upstream countries, without producing any of its own.

An analysis of the water dependency ratios of selected countries in Asia reveals a sharp imbalance and it reinforces China's status as an upstream superpower. For example, the country has a water dependency ratio of only 0.96 per cent, making it one of the world's most self-reliant countries in water resources. At the other end of the spectrum, countries in mainland Southeast Asia and South Asia, with the exception of Bhutan, have a water dependency ratio that signifies varying degrees of dependency on rivers that originated from outside their borders, China in particular. Thus, China's position as the source of Asia's great trans-boundary rivers and its low water dependency ratio gives it considerable heft in Asia's water affairs.

Water dependency ratio of selected countries in South and Southeast Asia in 2017

Regions	Countries	Water dependency ratio (%) in 2017
East Asia	China	0.96
Southeast Asia	Cambodia	74.67
	Laos	42.91
	Myanmar	14.13
	Thailand	48.81
	Vietnam	59.35
South Asia	Bangladesh	91.44
	Bhutan	0
	India	30.52
	Nepal	5.70
	Pakistan	77.71

Source: FAO. 2017.[8]

As Asia's pre-eminent hydro-hegemon, China has exercised a degree of hydro-hegemony over rivers that originated from within its border. Hydro-hegemony is defined as "Hegemony at the river basin level, achieved through water resource control strategies such as resource capture, integration, and containment. The strategies are executed through tactics (e.g., coercion-pressure, treaties, knowledge construction, etc.) that are enabled by the exploitation of existing power asymmetries within a weak international institutional context."[9]

A hydro-hegemon can exercise either a positive/leadership form of hydro-hegemony or a negative/dominative one. A positive/leadership form of hydro-hegemony is characterized by the hydro-hegemon leading and enabling co-operation among all riparian countries in areas such as river regulation and water sharing among others. A negative/dominative form of hydro-hegemony on the other hand is characterized by the hydro-hegemon acting in its own national self-interest and attaining and consolidating maximum control of water resources through unilateral actions. That can lead to competition and conflict among riparian countries over the use of trans-boundary rivers. China has chosen to exercise a negative/dominative form of hydro-hegemony in the context of rivers that it shared with South Asia and Southeast Asia.

Characterization of China as a negative hydro-hegemon was considered by some scholars as a "misunderstandings and misperceptions."[10] They argued that the country is "a positive hydro-hegemon" at least in the context of the Mekong River that it shared with countries in mainland Southeast Asia owing to its "leadership roles in establishing co-operation that facilitates the growth of the Mekong region."[11] This paper argues that the characterization of China as a positive hydro-hegemon is instead a misunderstanding and a misperception.

China views trans-boundary rivers as 'sovereign resources' that should be exploited in an unrestricted manner.[12] Such attitude has led the country

to view international water conventions and legally binding water treaties that are the bedrock of effective trans-boundary river co-operation as detrimental to its national interests and sovereignty. Not surprisingly, China has refused to sign the *1997 United Nation's Convention on the Law of the Non-Navigational Uses of International Watercourses* which is based on the principles of co-operation and mutual benefit and that sets out norms for effective trans-boundary river co-operation and management among riparian countries.

One Chinese scholar explained China's refusal to sign onto the Convention as: "China voted against the Convention for several reasons. One is it fails to consider the interests of upstream nations. The list of factors to be considered when determining reasonable use is incomplete and the duty not to cause significant harm means upstream states bear a greater responsibility. This is why most ratifying nations are downstream, or have no international watercourses. Second, the Convention requires nations to consult and negotiate with other nations on 'planned measures', which may damage national sovereignty. Third, the mechanisms for settlement of disputes include giving a fact-finding commission access to the respective territory. This too may damage national sovereignty and breaches China's long-held principle that third-parties should not intervene in disputes."[13]

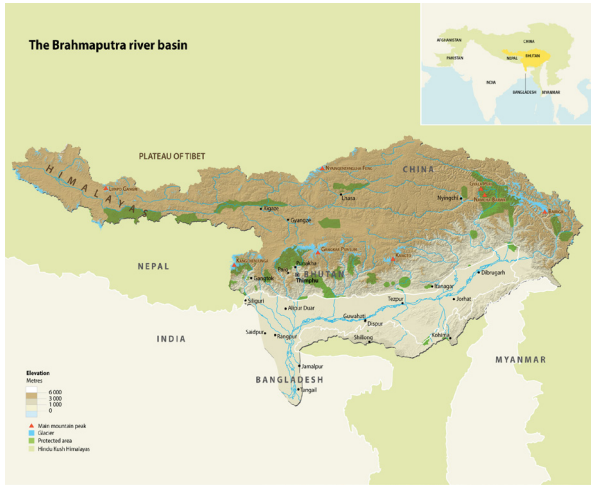
Thus, concerns about national sovereignty have led China to eschew rules-based and legally binding international water conventions such as the 1997 United Nation's Convention on the Law of the Non-Navigational Uses of International Watercourses. The country has also refused to sign legally binding bilateral or multilateral water sharing treaties with its downstream neighbours in Southeast Asia and South Asia. It reasoned that signing onto the convention and agreeing to legally binding bilateral or multilateral water sharing treaties with its downstream neighbours in Southeast Asia and South Asia would compromise its sovereignty and the right to maintain absolute control of rivers within its territory. China's insistence on absolute territorial sovereignty on its section of

trans-boundary rivers has enabled the country to build dams and other infrastructures unilaterally and without consulting downstream countries. That has frustrated its downstream neighbours and has raised tensions between them from time to time.

Case of the Yarlung Tsangpo River

The Brahmaputra River originated as the Yarlung Tsangpo in Southwest Tibet. Its source lies some 6,020 meters (19,750 feet/6 kilometer) above sea level at the foot of the Angsi Glacier in Burang County in Ngari Prefecture.[14] Because no continuously flowing river has a higher origin and a higher average elevation, the river is also known as the 'Everest of Rivers'.[15] The Yarlung Tsangpo flows 3,848 kilometers through the Tibetan Plateau in China, India, and Bangladesh where it merges with the Ganges and later the Meghna before it empties into the Bay of Bengal.[16] The river drains a total area of around 712,035 square kilometers in four countries namely China, India, Bangladesh, and Bhutan.

China accounts for 50.5 per cent of the Brahmaputra's drainage area, India accounts for 33.6 per cent, Bangladesh accounts for 8.1 per cent, and Bhutan accounts for 7.8 per cent.[17] In India, the Brahmaputra's drainage area is spread over a number of states of which Arunachal Pradesh accounts for 41.88 per cent, Assam 36.33 per cent, Nagaland 5.57 per cent, Meghalaya 6.10 per cent, Sikkim 3.75 per cent, and West Bengal accounts for 6.47 per cent. The Brahmaputra River is a source of life for more than 130 million people, the majority of which live in Bangladesh and India.[18] Despite this, there is a lack of an established legal framework for co-operation between China, Bangladesh and India over the Brahmaputra River. That has allowed China to act unilaterally and to opt against communicating with its riparian neighbours beyond the bare minimum.



Source: GRID-Arendal. 2015.[19]

Hydropower has played a significant role in facilitating China's rapid economic growth over the past few decades. The country has now built 46,000 dams, the world's largest, on virtually every river within its border.[20] The majority of Chinese dams comprised of large dams. Large dams are those that have heights of 15 metres or more and impounding more than 3 million cubic metres of water. As of 2020, China has 23,841 large dams, the world's largest.[21] In comparison, the US has 9,263 large dams, the world's second largest, and India has 4,407, the world's third largest. Approximately half of all the dams in China are used to produce energy and the remainder for agricultural and flood control purposes. Not surprisingly, China is the world's largest producer of hydropower with an installed capacity, according to the International Hydropower Association (IHA), of 356.4 GW in 2019. In comparison, India has an installed hydropower capacity of 50 GW, the world's fifth largest. After coal, hydro-electricity is now China's second-biggest source of energy making up almost 20 per cent of the country's total energy production. And as China seeks to meet its targets of becoming carbon neutral by 2060, the role of hydropower will continue to increase in the coming years.[22]

The rapid pace of China's dam building however has come at tremendous costs. The country has more than 50,000 rivers in the early 1990s, each with a catchment area of at least 100 square kilometers. However, according to China's first national census of water, the number of rivers in the country has declined to 22,909 by 2013.[23] In other words, more than 27,000 rivers in the country have disappeared between the 1990s and 2013. The Chinese government blamed climate change and statistical inaccuracies as the cause of their disappearance. Some analysts however argued that natural causes such as climate change were used as a scapegoat when in reality human interventions such as dams are to blame to the river's disappearance.

Source: Doman, Mark, Katia Shatoba, and Alex Palmer. 2021.[24]

In an effort to generate more hydropower to meet future demands for electricity, China has set its sight on Tibet's rivers. The Yarlung Tsangpo in particular is highly coveted for its unmatched potential. Although the river has the second highest hydropower potential in China after the Yangtze River, it has more power generating potential per unit of length than any other river in the country. Up until late 2000s, the Yarlung Tsangpo was the last of the great Tibetan rivers that had yet to be dammed. It is also

Asia's last major free-flowing river up to that point. That changed as China began prioritizing the development of hydropower resources in Tibet. Baima Wangdui, director of Tibet's water resources department, observed in 2008 when plans for building dams on the Yarlung Tsangpo River were at a nascent stage that "The upper reaches of the rivers it is forbidden to develop; the middle reaches [in places like Lhasa and Xigatze] are more populated and can have limited development under certain conditions and can keep the balance with environmental protection; the lower reaches of those rivers in the deep valleys and some remote areas are the main part we are developing."[25]

Estimating the exact numbers of China's planned construction of dams on the Yarlung Tsangpo proves difficult owing to the country's penchant for secrecy in divulging such information. Nevertheless, Tashi Tsering, a Tibetan scholar of environmental policy at the University of British Columbia at Vancouver in Canada, estimated in 2010 that "more than 28 dams" are either planned or under discussion by China.[26] Yet others counted eight dams.[27] An analysis of various media reports however mentioned five dams – Zangmu, Jiacha, Zhongda, Jiexu, and Langzhen - that have either been constructed or are approved for construction on the middle reaches of the Yarlung Tsangpo River.[28]

Construction of the first dam, the 510 MW Zangmu Hydropower Station, began in 2009 in Gyaca County in Shannan Prefecture and it was completed in 2015. This dam was hailed as ushering in "a hydropower era for Tibet's rivers."[29] Construction of a second dam, the 360 MW Jiacha Hydropower Station, soon followed in 2015 in the same stretch of the river in the same county and it was completed in 2020.[30] The remaining three dams are believed to be in various stages of planning, engineering, and construction. China claimed that these are small-scale projects and are of run-of-the-river types that do not require large reservoirs or storage as they generate power from the natural flow of rivers and therefore will have little or no adverse impact on India. Even so, multiple dams that

are located in close proximity to each other may still lead to significant changes in the flow of water downstream.

Of particular concern to India however is China's plan to construct a sixth dam, this time on the lower reaches of the Yarlung Tsangpo close to the Indian border. The Yarlung Tsangpo flows from west to east for much of its journey through open valleys on the Tibetan Plateau north of the Himalayas. However, as the river reaches the eastern end of the Himalayas in Southeastern Tibet, it makes an abrupt and dramatic hairpin turn and pushes its way towards the west between the Namcha Barwa (7,782 metres/25,531 feet) and Gyala Peri (7,294 metres/23,930 feet) mountains in Medog County in Nyingchi Prefecture. This section of the river is known as The Great Bend. Here, the Yarlung Tsangpo plunges nearly 2,500 meters (8,202 feet) through the world's deepest gorge, the Yarlung Tsangpo Grand Canyon of depths reaching over 5,300 metres (17,388 feet). The huge drop in elevation in this section of the Yarlung Tsangpo offers the greatest untapped hydropower resources on the planet.

Harnessing that potential has long been a dream of Chinese hydro-engineers. But accessing it was thought to be impossible owing to harsh and unforgiving terrain. However, that has not dissuaded Chinese hydro-engineers from making bold proposals. One such proposal was for a 38 GW hydropower station. Zhang Boting, deputy general secretary of the China Society for Hydropower Engineering (CSHE), told the UK-based *The Guardian* newspaper in May 2010 that such a dam "could generate energy equivalent to 10 million tonnes of crude coal, or all the oil and gas in the South China Sea" and "save 200 million tonnes of carbon each year."[31] That proposal however failed to get the Chinese government's approval. Then on 29 November 2020, speaking at a conference to celebrate the 40th anniversary of the founding of CSHE in Beijing, Yan Zhiyong, chairman of the state-owned Power Construction Corporation of China (POWERCHINA), outlined his company's plan to build a dam on the same section of the Yarlung Tsangpo River.

The dam, according to Mr Yan, will be so big that it will have "no parallel in history."[32] Dubbed a 'super dam' by various media reports, the proposed dam will have a capacity to generate around 60 GW of electricity, triple that of the Three Gorges Dam on the Yangtze River in Hubei Province which currently has the world's largest installed hydropower capacity at 22.5 GW, enough to power more than 18 million homes.[33] Besides generating USD 3 billion in income annually for Tibet, it was hoped that the dam will help China reach carbon emissions peak before 2030 and carbon neutrality in 2060. Mr Yan also revealed that POWERCHINA has signed a 'strategic cooperation agreement' with the Tibetan government on 16 October 2020 to expedite the dam's construction. This time, the proposed dam received official approval.

On 11 March 2021, the National People's Congress, China's parliament, adopted the country's 14th Five-Year Plan that set economic development priorities from 2021 to 2025. Among the key infrastructure projects included in it were dams on the lower reaches of the Yarlung Tsangpo including the one proposed by Mr Yan. Thus, construction of a super dam at The Great Bend section of the Yarlung Tsangpo River could commence in the coming years. When asked about the dam on 2 December 2020, Ji Rong, spokesperson of the Chinese Embassy in India, replied that "China has always taken a responsible attitude towards the development and utilization of cross-border rivers, and adopts a policy that protection goes together with development. Any project will undergo scientific planning and demonstration with full consideration for the impact on the downstream areas and the interests of both upstream and downstream countries. At present, the downstream development of the Yarlung Zangbo River is still in the stage of preliminary planning and demonstration. There is no need to over-interpret it."[34]

Besides dams, the prospect of China diverting the waters of the Yarlung Tsangpo River has also weighed heavily on India. Water diversion projects are seen as the answer to address China's water problems. Although

China's freshwater supply is vast in absolute terms, there is a huge imbalance between southern and northern China. Northern China is an industrial, agricultural, and political powerhouse. But it has only eight per cent of the country's total water resources and very low per capita water availability. Southern China on the other hand has surplus water owing to high precipitation and an abundance of perennial rivers. Recognising this, Mao Zedong, during an inspection tour of the Yellow River in October 1952, remarked that "The South has plenty of water, and the North lacks it. So, if possible, why not borrow some?"[35]

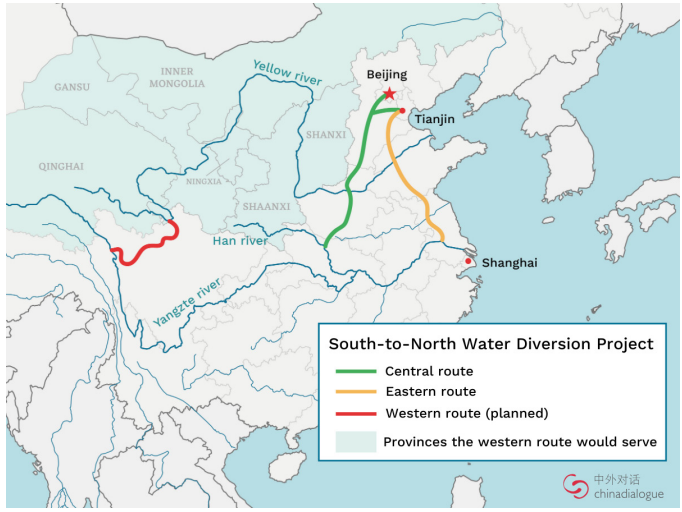
This comment set into motion efforts by China to transport water over long distances to supply the resource-rich arid regions of northern China and it culminated into the South-North Water Transfer Project (SNWTP). Also known as the South-North Water Diversion Project (SNWDP), it was approved in December 2002. The project is one of the infrastructure centerpieces of China's 10th Five-Year Plan that set economic development priorities from 2001 to 2005. It was also seen as a critical step in Chinese President Hu Jintao's "Scientific Development Policy." That policy uses engineering, technology, and modern policy to address China's important resource challenges. SNWTP is both the most expensive (it costs more than USD 80 billion) and expansive (it encompasses 20 provinces) Chinese infrastructure project since 1949. And it is also the largest water transport system in the world prompting analysts to liken it to "replumbing an entire nation."[36] The project consisted of more than 3000 kilometers network of canals and tunnels that are designed to divert 44.8 billion cubic metres (11.8 trillion gallons) of water annually from China's longest river, the Yangtze, to its northern regions through three routes: eastern, middle, and western:-[37]

1. **Eastern Route**: Construction of the 1,800 kilometers Eastern Route began in 2002 and was completed in 2013. It started from the lower reaches of the Yangtze River in Jiangsu Province to transfer water to Anhui, Shandong, and Hebei provinces, as well

as the city of Tianjin. It has the capacity to transfer 14.8 billion cubic meters of water annually.[38]

2. **Middle Route**: Construction of the 1,432 kilometers Middle Route began in 2003 and was completed in 2014. It started from the Danjiangkou Reservoir on the Hanjiang River, a major tributary of the Yangtze River in Hubei Province, to transfer water to Henan and Hebei provinces as well as to cities like Beijing and Tianjin. It has the capacity to transfer 13 billion cubic meters of water annually.

3. **Western Route**: It still remains in the conceptual stage. The Western Route is projected to transfer 8 billion cubic meters of water annually from three tributaries of the Yangtze River in Tibet - Tongtian, Yalong, and Dadu rivers - to northwest China where it will help replenish the Yellow River. This route however is considered to be the most controversial, most technically difficult, and potentially the most economically infeasible of the three routes.



Source: Gao, Baiyu. 2020.[39]

SNWTP was hailed as an engineering marvel and was uniformly viewed as the only credible way to supply northern China with water. As of 12 December 2020, the eastern and middle routes transferred 39.4 billion cubic meters of water to northern China benefitting more than 120 million people.[40] As these sections of the SNWTP draws water primarily from the Yangtze River, it does not pose a threat to downstream countries like India. However, the Western Route section of the SNWTP poses major challenges to India as it could potentially transfer the waters of trans-boundary rivers like the Yarlung Tsangpo River. As has already been discussed, the official plan for the Western Route envisages the transferring of eight billion cubic meters of water annually from three tributaries of the Yangtze River in Tibet - Tongtian, Yalong, and Dadu - to northwest China where it will help replenish the Yellow River. But various unofficial plans have also been floated by individuals that involved transferring the waters of the Yarlung Tsangpo, Salween, and Mekong rivers to places as far as Tianjin and Xinjiang. These proposals have been dismissed by various Chinese experts as "not necessary, unfeasible, unscientific"[41] and "whimsical ideas."[42] But interests in the project remained. At the inauguration ceremony of the South-North Water Diversion Group that was held in Beijing on 23 October 2020, China's premier Li Keqiang called for "options" to be examined for the Western Route section of the SNWTP.[43] The South-North Water Diversion Group is a state-owned enterprise that was established to oversee the management of SNWTP and to fundraise and attract expertise. Given the high level of interest, there is a high probability that construction of the Western Route could commence in the coming years.

Hydrological Implication of Chinese Dams on the Yarlung Tsangpo River

In India, the potential implication of Chinese dams on the Yarlung Tsangpo River is understood primarily in hydrological terms. Hydrology is "the study of the distribution and movement of water both on and

below the Earth's surface, as well as the impact of human activity on water availability and conditions."[44] Dams have the potential to affect the river's hydrology – water volume and water quality - and induce natural disasters such as landslides and earthquakes. Dams on the Yarlung Tsangpo may withhold, block or restrict water during the dry seasons. That could reduce the flow of water in the Siang and the Brahmaputra rivers in Arunachal Pradesh and Assam affecting irrigation, rice production, fisheries etc. Conversely, dams in the river may release excess water from their reservoirs when they reach capacity during the wet season. That appears to be India's biggest concern at the moment.

Assam is highly vulnerable to floods. It experiences at least three to four waves of flood from June to September every year. An estimated 39.58 per cent (31.05 lakh hectares) of the state's total land area is classified as flood prone.[45] Of this, 30 per cent (9.31 lakh hectares) gets affected directly and frequently. Flood causes large scale erosion of riverbanks in Assam. And since 1954, the state has lost 7.40 per cent (4.3 lakh hectares) of its total land area, mostly riverine fertile agricultural lands, to riverbank erosion. Furthermore, the average annual economic cost of floods to the state was estimated at Rs 200 crore. To mitigate the disastrous impacts of floods, India and China signed the 'Memorandum of Understanding (MOU) on Provision of Hydrological Information on Brahmaputra River in Flood Season' in 2002. The agreement required China to share hydrological data (water level, discharge, and rainfall amount) of the Yarlung Tsangpo River to India during the monsoon/flood season from 1 June to 15 October every year.[46] The data are sourced from three hydrological stations located at Nugesha, Yangcun, and Nuxia in Tibet. Since 2013, the provision of hydrological data sharing has been extended to cover the period from 15 May to 15 October. And since 2018, China has agreed to provide hydrological data during the non-monsoonal/non-flood season if water levels in the Yarlung Tsangpo exceeded mutually agreed limits.[47] It is important to note that India paid Rs 82 lakhs to China every year to obtain hydrological data.[48] The money was ostensibly used by China to

maintain its three hydrological stations.

Nimmi Kurian, Professor at the Centre for Policy Research (CPR) in New Delhi, likened this money-for-data arrangement to "transactional notion of reciprocity." Such arrangement has reduced the nature of cooperation between China and India over shared water resources to a commercial arrangement that can be terminated at will. China has demonstrated its willingness to do just that in the recent past. Following the tense 73-day military stand-off between China and India at Doklam in 2017, the country abruptly halted the sharing of hydrological data to India for that year. The military stand-off was precipitated by China in June when it attempted to build a road in Doklam sparking Indian intervention. It ended in August after both sides agreed to withdraw from the area. It was against this backdrop that Raveesh Kumar, spokesperson of India's Ministry of External Affairs, disclosed on 18 August 2017 that India had not received hydrological data from China despite an agreement between the two countries.[49] China's Ministry of Foreign Affairs however maintained a stony silence for nearly a month. On 12 September 2017, its spokesperson finally acknowledged China's failure to provide hydrological data to India. He reasoned that the hydrological stations in Tibet are unable to collect data as they have been damaged by floods in 2016 and therefore have to be upgraded and renovated.[50] Despite this assertion, China still shared hydrological data on the Yarlung Tsangpo River with Bangladesh. Analysts believed that China's withholding of hydrological data from India was intended as a "punishment" for its involvement in Doklam.[51]

China's action rekindled India's fears about the country's potential use of water as a weapon. The use of water as a weapon or 'water weaponization' refers to "the use of water as physical arms to harm and/or gain leverage over an adversary" and is typically carried out through "deprivation (too little water) and inundation (too much)" and is "oriented toward strategic and tactical ends."[52] While China's withholding of hydrological data from

India cannot be characterized neatly as a case of water weaponization - it did not involve the manipulation of river flow - it amounted to the weaponization of hydrological data. As a result, data that could have been used for flood prevention measures in Arunachal Pradesh and Assam was unavailable to India. This could set a new and dangerous precedent. The prospect of China using water as a coercive tool of diplomacy and as a weapon by manipulating the flow of water in the Yarlung Tsangpo River during moments of heightened crisis therefore cannot be ruled out in the years ahead.

There are also concerns about dams in the Yarlung Tsangpo inducing natural disasters like landslides and earthquakes. The Himalayan region, including the Tibetan Plateau, is prone to major landslides and that could have disastrous impacts along the river. On 17 October 2018, a landslide in Menling County, just 100 kilometers from the Indian border, blocked the flow of the Yarlung Tsangpo that resulted in the formation of a barrier lake in the river.[53] The next day, the level of water in the lake rose by as much as 40 meters (141 feet). That prompted China to evacuate more than 6000 people. As a result of the barrier lake in the Yarlung Tsangpo River, the Siang River in Arunachal Pradesh was reported to have almost dried up and state authorities warned people not to venture near the river for fear of a flash flood in an event that the barrier lake burst without warning.[54] Similar alert was also issued in Assam. Again, on 22 March 2021, a hanging glacier and rocks high in the mountains near The Great Bend section of the Yarlung Tsangpo in Medog County, located just 50 kilometers from the Indian border, broke free and 100 million tonnes of ice and rock debris plummeted almost 4 kilometres down to the river below.[55] It partially blocked the Yarlung Tsangpo and its upstream section swelled as a result.

Besides blocking the flow of the river and causing floods downstream, landslides also affect the quality of the river's water. Towards the end of 2017, the normally clear waters of the Siang River turned black for

months due to high turbidity.[56] Turbidity is a measure of the cloudiness or haziness of water because of the presence of clay, silt, organic and inorganic matter etc. Whereas the level of turbidity under normal circumstances at that time of the year generally hovered between 12 and 15 Nephelometric Turbidity Unit (NTU), a laboratory test confirmed a high level of turbidity that measured 425 NTU in December 2017. This was more than 400 times higher than the permissible limit of 5 NTU for drinking water. Turbidity level of more than 425 NTU for extended period could seriously imperil aquatic life as it could choke them to death. Because building dams requires the clearance of vast areas of land, there is a likelihood of more landslides occurring along the Yarlung Tsangpo River in the future. That would potentially endanger the lives of people living along the Siang and the Brahmaputra rivers in India.

The Yarlung Tsangpo River Basin is situated in a high seismicity zone. The rocks beneath the river basin are geologically young and they are still in active formation. Thus, geological volatility makes the river basin highly vulnerable to earthquakes. There is also the risk of dams triggering earthquakes in the region. Dam-induced earthquakes, also known as Reservoir-Induced Seismicity (RIS), occur in two ways.[57] First, the added weight of a reservoir increases stress to faults and causes them to rupture. A fault is a fracture or zone of fractures between two blocks of rock. Second, water from the reservoir seeps into the rock and changes the fluid pressure in micro-cracks and fissures in the ground under and near a reservoir. China is no stranger to dam-induced earthquake. The magnitude 7.9 earthquake that struck Sichuan Province on 12 May 2008 was attributed to the 760 Megawatt (MW) Zipingpu Dam that was built less than two kilometers from a major fault line. Growing body of evidence suggests that the weight of the dam's reservoir may have helped to "trigger"[58] or "hasten"[59] the earthquake. The earthquake resulted in the death of 87,000 people and it injured 370,000 others.[60] Given the fact that dams on the Yarlung Tsangpo River are located in close proximity to each other, like pearls on a string, it is probable that the collapse of one of them would

cause the others to also collapse like dominos. The sudden rush of water would then cause major devastation in Arunachal Pradesh and Assam.

China has yet to build all the proposed dams on the Yarlung Tsangpo and the vast majority of them are in various stages of planning and construction. As a result, our understanding about the hydrological implications of Chinese dams on India remained limited at this point. The full magnitude of their hydrological impacts will come to light after most, if not all, of the dams have been completed. Even that will be difficult to gauge given China's penchant for secrecy. And it is highly unlikely that China will voluntarily divulge the progress of its dam building spree to India. India therefore has no way of confirming it. The country has been tight-lipped about its plans on the Yarlung Tsangpo River right from the very beginning. For example, when China begun building its first dam on the river, it chose not to divulge any information about it. Even when satellite pictures confirmed the country's construction of a dam at Zangmu in 2009, China still denied that it was building a dam. It was only after much persuasion by India that China finally admitted to the dam's existence in early 2010. Thus, China's lack of transparency over its planned construction of build dams on the Yarlung Tsangpo River necessitated heightened vigilance on India's part.

The Mekong River offers a cautionary tale of the perils of China's dams on downstream countries and the hollowness of its assurances that it will have no adverse impacts on downstream countries. The river is the longest in Southeast Asia. Like the Brahmaputra, it originated in the Tibetan Plateau as the Lancang and flows approximately 4,909 km through six countries - China, Myanmar, Laos, Thailand, Cambodia, and Vietnam - before emptying into the South China Sea. It drains a total land area of 795,000 square kilometers and underpins the economic security of more than 60 million people downstream. China's section of the river contributed 31 per cent of the Mekong's total flow during the flood season and 35 per cent during the dry season.[61] Thus, the country's 11 operational

dams as of 2020 that are constructed between 1993 and 2018 have the potential to seriously affect the flow of water into the Mekong River. A report published on 10 April 2020 by Eyes on Earth Inc, a US-based research and consulting firm specialising in water, laid bare the impact of China's dams on the Mekong River. The most significant finding of the report is that from April to November 2019, China's section of the Mekong River received uncommonly high levels of precipitation, yet its dams blocked or restricted more water than ever as downstream countries in Southeast Asia suffered through an unprecedented drought, the worst in more than 50 years. The drought devastated farmers and fishermen and saw the massive river recede to expose sandbanks along some stretches and at others turned from its usual murky brown to bright blue because waters were so shallow and lacking in sediment.

Predictably, China dismissed these findings and denied any wrongdoing. The country's Ministry of Foreign Affairs said in a statement to *Reuters* that "The explanation that China's dam building on the Lancang River is causing downstream droughts is unreasonable."[62] It maintained that China continued to guarantee reasonable discharge volumes in 2019 despite the record low levels of water at its reservoirs on the Lancang River due to a serious drought in the country's Yunnan Province. However, according to one expert, that assertion is "inconsistent with the (Eyes on Earth Inc's) study's data" and that "either Beijing is lying or their dam operators are lying to them."[63] Since the beginning of January 2021, the Mekong River again experienced a considerable drop in its water levels that was described by the Mekong River Commission (MRC) as "worrying."[64] China's decision to restrict the water released from one of its dams in Yunnan Province from 5 to 24 January due to "grid maintenance" is believed to have contributed in large part to the low water levels in the Mekong River. As a result of reduced flows, certain sections of the Mekong River turned bluish-green and it may impact the productivity of aquatic biodiversity, reducing fish catches, and threatening the livelihoods of local communities.

It is interesting to note that China viewed Southeast Asia as "potentially the most fruitful and receptive region for the projection of Chinese influence."[65] The country's relations with the region have been described by some analysts as either part of a traditional "Confucian tribute system" or, more recently, as part of a more Western concept of a "sphere of influence." If China can have no qualms about exerting a degree of hydro-hegemony over countries that it considered are part of its traditional sphere of influence, its exercise of a negative/dominative form of hydro-hegemony over India, a peer-competitor, should come as no surprise after all.

Source: Eyler, Brian and Courtney Weatherby. 2020.[66]

Strategic Implications of Chinese Dams on the Yarlung Tsangpo River

Growing number of Indian experts have questioned the merit of India's concerns over Chinese dams on the Yarlung Tsangpo River. One of them observed that "China accounts for almost half the basin area, but it actually contributes a fraction of the system's input of waters. The narrow Yarlung Tsangpo actually becomes the mighty Brahmaputra only after it enters India after the Great Bend." As such, he deemed the narrative that was internalized in India as full of "jingoism and ignorance" and India's concerns as "bogus"[67] and "misplaced."[68] Another expert called China's planned diversion of the waters of the Yarlung Tsangpo River a "myth" spread by the Indian media.[69] He accused the Indian media of perpetuating a "jingoistic narrative" that was based not on science and real data but on emotions. Yet another expert argued that China's "dominance" of the Brahmaputra River was "overstated" and demanded that Chinese hydro-hegemony be de-emphasized.[70] While there is no arguing against the fact that the Bramaputra's flow are generated primarily within India, the observation that India's concern is "bogus" and "misplaced" is flawed. These experts based their arguments solely on the river's hydrology. Missing from their observations are the potential strategic implications of dams on the Yarlung Tsangpo River.

Chinese dams on the Yarlung Tsangpo River close to the Indian border have the potential to consolidate China's claims on disputed territories such as Arunachal Pradesh and therefore it threatens India's national security and territorial integrity. India shares 3,488 kilometers of border with China that runs along the Union Territory of Ladakh and the states of Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh. The border, known as the Line of Actual Control (LAC), partially adheres to boundaries drawn by the British in 1914 between Tibet and India. India and China however disagrees over where the LAC lies. As a result,

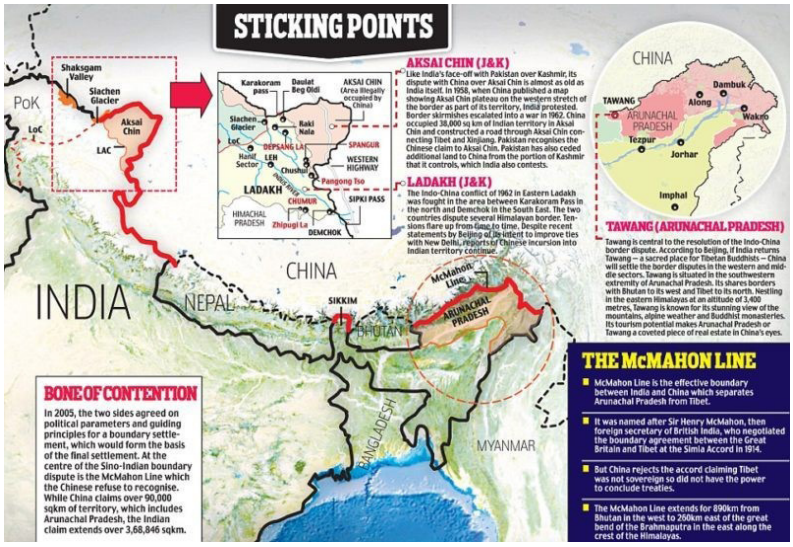
territorial dispute existed across three different areas:-

1. **Eastern Sector**: China disputes the legality of the McMahon Line and claims approximately 90,000 square kilometers of territory that roughly corresponds to the Indian state of Arunachal Pradesh. In fact, China's claim is larger than the state's actual size of 83,743 square kilometers. It is probable that China's claims extended beyond Arunachal Pradesh into portions of the Assam Plain/Brahmaputra Plain.

2. **Middle Sector**: China claims about 2,000 square kilometers of territory in the Indian states of Himachal Pradesh and Uttarakhand.

3. **Western Sector**: China is in illegal occupation of 38,000 square kilometers of territory in the Union Territory of Ladakh. It has also illegally acquired 5,180 square kilometers of territory in the Shaksgam Valley in Pakistan Occupied Kashmir (POK) on 2 March 1963.

According to M. Taylor Fravel of the Massachusetts Institute of Technology (MIT), the Sino-Indian border dispute is "perhaps the world's most continuously negotiated territorial dispute."[71] He wrote in 2020 that "Since 1981, negotiations or talks regarding the border have been held every single year - for thirty-eight years. This includes eight rounds at the vice-ministerial level in the 1980s, fifteen meetings of the joint working group from 1989 to 2005, and twenty-one meetings of the special representatives at the level of national security advisor since 2003. Moreover, several agreements on confidence-building measures were concluded in the 1990s, along with agreements relating to principles for settling the dispute or managing the border in 2005 and 2013."



Source: knowledgekart.in 2012.[72]

Mr Fravel contended that despite these talks and agreements, "a final settlement of the border dispute has remained elusive, and the two sides appear no closer to reaching agreement today than they did when negotiations resumed in 1981." If anything, dispute between India and China has become increasingly tense over the past few years. For example, on 15 June 2020, a violent brawl erupted between Indian and Chinese troops in Galwan Valley in the Union Territory of Ladakh that resulted in 20 Indian and an unknown number of Chinese soldiers dead. This was the first fatal confrontation between the two countries since 1975 when Chinese troops ambushed and killed four Indian soldiers at Tulung La in Arunachal Pradesh. It was also the deadliest clash between the two countries since 1967 when Indian and Chinese forces engaged in a skirmish at Nathu La and Cho La in Sikkim that resulted in over 80 Indian and hundreds of Chinese soldiers dead. Although much of India's current focus is on Ladakh, given recent tensions there, experts have warned that in the larger scheme of things, Arunachal Pradesh is more consequential for both countries.[73]

Arunachal Pradesh, located at India's northeast, has been a key point of contention between India and China for several decades. The state covers an area of 83,743 square kilometers, nearly 60 per cent of the total area of India's northeastern region, and has a population of 1.25 million as of 2012. It accounted for 1,126 kilometers or 32.28 per cent of India's 3,488 kilometers of border with China which it shares with Tibet's Shannan and Nyingchi prefectures. China's claims initially centered on Tawang which is located in the western part of the state. Tawang is home to the Monpa ethnic group. The Monpas practice Tibetan Buddhism, speak a language similar to Tibetan, and once paid tribute to rulers in Lhasa. It is also home to one of Tibetan Buddhism's most sacred monasteries, the Tawang Monastery, which was founded in 1681. The monastery is the largest Tibetan monastery in India and the second largest in the world after the Drepung Monastery in Lhasa. Furthermore, Tsangyang Gyatso, the sixth Dalai Lama (spiritual head), was born in Tawang in 1683.

China's Border Claims

Tawang formally became a part of modern India following the signing of a boundary treaty between India and Tibet at Shimla in 1914. The treaty established a border, the McMahon Line, between them. The McMahon Line appeared on an official Survey of India map for the first time in 1937 and Tawang came under effective Indian administrative control in 1951. Tawang is now the district headquarters of Tawang district which was formed in 1984. The district covers 2,172 square kilometers and has a population of 49,977 as of 2011. China viewed the McMahon Line as "a product of the British policy of aggression against the Tibet Region of China" and it aroused "the great indignation of the Chinese people."[74] It therefore did not recognize it as the official boundary between itself and India. Nevertheless, in April 1960, Chinese Premier Zhou Enlai, during his visit to India, offered the Indian Prime Minister Jawaharlal Nehru a "package deal" compromise settlement to address the border dispute. Zhou

summed up his offer as, "You keep what you hold, you take too anything that is in dispute and occupied by neither, and we keep what we hold."[75]

In other words, China was ready to recognize India's claim in the Eastern Sector (in Arunachal Pradesh) if India accepted its claim in the Western Sector (in Aksai Chin). For Zhou, Aksai Chin holds great strategic value compared to Arunachal Pradesh. The region was occupied by China in the 1950s and the country has built a strategic road in it to connect the newly acquired regions of Xinjiang and Tibet. The road is now known as the China National Highway 219 (G219). It measures 1,455 kilometers and connects the town of Yecheng in Xinjiang to Shiquanhe in Tibet. Nehru refused to accept Zhou's offer because he wanted to settle each disputed sectors separately and not as a package. Moreover, he believed in the validity of historical agreements and therefore considered the McMahon Line as the official boundary between China and India. It has since been argued that had Nehru accepted Zhou's proposal, "India and China, after some negotiations, could have fixed the boundary permanently" and that would have prevented a war between the two countries in 1962.[76]

The 1962 Sino-Indian War resulted in the consolidation of Chinese control over Aksai Chin and this led to a reversal of China's position on the Sino-Indian border dispute. From the 1980s onwards, China sought Indian concessions in the Eastern Sector in return for Chinese concessions in the Western Sector.[77] And in 1985, it specifically stated that the concession it sought from India was Tawang. This position was reaffirmed most recently by Dai Bingguo, China's Special Representative for border talks with India from 2003 to 2013. He observed during an interview in 2017 that "If the Indian side takes care of China's concerns in the Eastern Sector of their border, the Chinese side will respond accordingly and address India's concerns elsewhere."[78]

Then from 2006 onwards, China's position changed once more. Chinese officials have taken to calling the state "South Tibet" or '*Zangnan*' and

claimed sovereignty over the entire state. This position was announced publicly for the first time by China's Ambassador to India Sun Yuxi in November 2006. In an interview with an Indian news channel days ahead of Chinese President Hu Jintao's visit to India, he declared that "In our position, the whole of what you call the state of Arunachal Pradesh is Chinese territory and Tawang (district) is only one place in it and we are claiming all of that - that's our position."[79]

For India, China's claims on Arunachal Pradesh, either in part or as a whole, is "neither practical nor possible."[80] This is because Arunachal Pradesh is an inhabited area and an inalienable part of the country. Its status therefore is "not negotiable."[81] India's position has been supported by countries like the United States. Kenneth Galbraith, US Ambassador to India, declared on 27 October 1962 that "The McMahon Line is the accepted international border and is sanctioned by modern usage. Accordingly, we regard it as the northern border of the [North East Frontier Agency] region."[82] This has since remained the official American policy on the issue. In the wake of the border crisis between India and China in Ladakh in 2020, the United States once again reiterated that "We have our position on some parts of the border which is explicitly clear. For nearly six decades, the United States has recognized Arunachal Pradesh as Indian territory."[83]

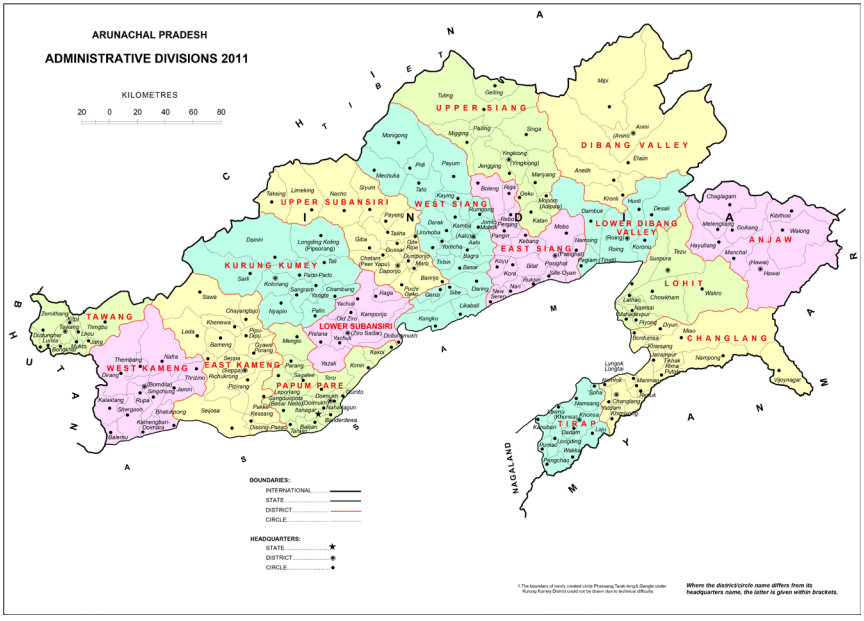
The continued existence of Arunachal Pradesh outside China's control deeply worries China. The country sees Arunachal Pradesh, Tawang in particular, as an unfinished agenda of its annexation of Tibet. As a result, it has symbolic resonance for the country's legitimacy, the Chinese Communist Party's legitimacy in particular, over the region. Furthermore, Tawang enabled Tibetan nationalism to fester internationally and it has become a proxy battleground between China and the Dalai Lama who is considered a living Buddha of compassion and a reincarnation of the bodhisattva Chenrezig. China viewed him as a dangerous "splittist" and a "wolf in monk's clothing" that seeks to destroy the country's sovereignty. For

the Dalai Lama, Tawang evoked memories of his escape from Communist tyranny and he has huge emotional attachment to the place. During his visit to the area in 2017, he noted that "Every time I visit these areas, the Tawang area, it is very emotional for me. I see a place where I had enjoyed freedom for the first time."[84]

Having fled Tibet on 17 March 1959 following a failed uprising against Chinese rule, the then 23 year old 14th Dalai Lama, Tenzin Gyatso, reached Tawang on 31 March 1959. He took refuge at the Tawang Monastery before heading to Mussoorie where he established a Tibetan government-in-exile, the Central Tibetan Administration (CTA), on 29 April 1959. He, and his government, eventually settled down in Dharamsala in Himachal Pradesh in 1960. The Dalai Lama continued to maintain close links with Tawang by appointing the head of the Tawang Monastery and giving the monastery financial support. And in 2008, he announced for the first time that Tawang was a part of India.[85] The Dalai Lama also sought to consolidate Tibetan Buddhism's deep roots in Tawang by visiting the place from time to time. According to some experts, the visits are an indication that the Dalai Lama is laying the groundwork for a reincarnation in Tawang. This is deeply discomforting for China as it wanted to control the process of future reincarnations by identifying and promoting its own candidate. Towards this end, the country passed a government regulation on 18 July 2007 declaring that henceforth only it is allowed to permit a lama to reincarnate.[86] In light of these, China's control over Arunachal Pradesh could deal a fatal blow to Tibetan nationalism and it will mark the completion of the country's annexation of Tibet.

There are other reasons too. Control over Arunachal Pradesh could help China gain strategic and tactical advantage over India. Arunachal Pradesh overlooks the Brahmaputra Plain, also known as the Assam Plain. The Brahmaputra Plain is long and narrow - it is 640 kilometers long and 64 to 90 kilometers wide. It is densely populated and is vital to the economy

of not just Assam but of the northeastern region of India. Besides, it is contiguous with the Indo-Gangetic Plains and they are often considered one physiographic unit. Control over Arunachal Pradesh would therefore enable Chinese forces to use their positions on higher ground to cut off India's northeastern region from the rest of the country. China also has much to gain from Arunachal Pradesh's considerable natural resources which include water, fertile soil, forestry, petroleum, natural gas, coal, fuller's earth, dolomite, graphite, limestone, quartzite, uranium etc. Maximising the use of these resources would significantly boost China's economy.



Source: Sharma, Manas. 2016.[87]

Furthermore, control over Arunachal Pradesh would enable China to exploit the volatile security situation in Northeast India. India's northeastern region, which comprises of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, have long struggled with armed ethnic insurgencies some of which dates back to the 1950s. The numerous armed insurgents groups in the region fought for greater autonomy within

the states that they operated in. Some groups however demanded outright independence from India. Situations have improved in recent years due to a number of reasons including all-round economic development, ceasefire agreements and peace talks between armed insurgent groups and the Indian government etc. As a result, insurgency-related incidents across the region have decreased by 80 per cent and civilian deaths by 99 per cent in 2020 compared with 2014.[88] The overall security situation has now been described as reaching "satisfactory level" by the Ministry of Home Affairs (MHA). China's control over Arunachal Pradesh, and the state's proximity to Nagaland, Assam, Manipur etc, could enable the country to sabotage India's hard-won peace in the northeast. The country has a history of supporting rebel groups in the region, the Naga rebels in particular. It could revitalize those links and leverage them to destabilize India through arms sales, training, and even by offering them safe havens in Arunachal Pradesh. On the whole, Chinese control over Arunachal Pradesh has the potential to significantly affect India's national security and irreparably change the strategic balance in South Asia.

Advancing Chinese Territorial Claims on Arunachal Pradesh

China attempts to advance its territorial claim on Arunachal Pradesh in two ways – shaping and controlling the narrative through *propaganda/ influence operations* and *building infrastructure*. 'Influence operations' has been described as "A broad range of non-kinetic, communications-related, and informational activities that aim to affect cognitive, psychological, motivational, ideational, ideological, and moral characteristics of a target audience."[89] In other words, it is state-sponsored propaganda campaigns against adversaries. Influence operations is an integral part of China's "Three Warfares" concept that was adopted in 2013 by the Central Committee of the Chinese Communist Party, China's highest organ of authority, and the Central Military Commission, its highest military policy-making body. The Three Warfares concept aimed to establish 'discursive power', defined as "the power to control perceptions and shape narratives that

serve Chinese interests, while undermining those of an opponent," over an adversary through three types of non-kinetic or non-lethal warfare: media warfare, psychological warfare, and legal warfare.

For example, China declared on numerous occasions that Arunachal Pradesh was illegally established on Chinese territory by India and has included the state in its official maps. It has also opposed visits to the state by Indian, Tibetan, and foreign leaders and has even unsuccessfully blocked attempts by the Asian Development Bank (ADB) to finance projects in Arunachal Pradesh. And in an effort to cast doubts over the citizenship status of residents of Arunachal Pradesh, the Chinese Embassy in India has denied visas to them on various occasions, claiming that since the state is a part of China, its residents are Chinese citizens and they do not need visas to travel to their own country. When it did issue visas, it provided them stapled visas. Stapled visas are paper visas stapled to the passport and India does not consider them valid for travel out of the country. To India, stapled visas are a form of discrimination by China against legitimate visa applicants of Indian nationality based on their domicile and ethnicity. Also, in order to create a legal basis of its claims, China renamed six places in Arunachal Pradesh. On 14 April 2017, the country's Ministry of Civil Affairs released the "standardized names" of the six places in Chinese, Tibetan, and Roman alphabet. The names in the Roman alphabet are Wo'gyainling, Mila Ri, Qoidêngarbo Ri, Mainquka, Bümo La, and Namkapub Ri.[90] According to one Indian analyst, Wo'gyainling referred to Urgelling village, Mila Ri and Qoidêngarbo Ri referred to a point on a mountain slope and a peak, Mainquka referred to Mechuka town, and Bümo La referred to a point on a mountain slope.[91] What Namkapub Ri refers to remained unclear.

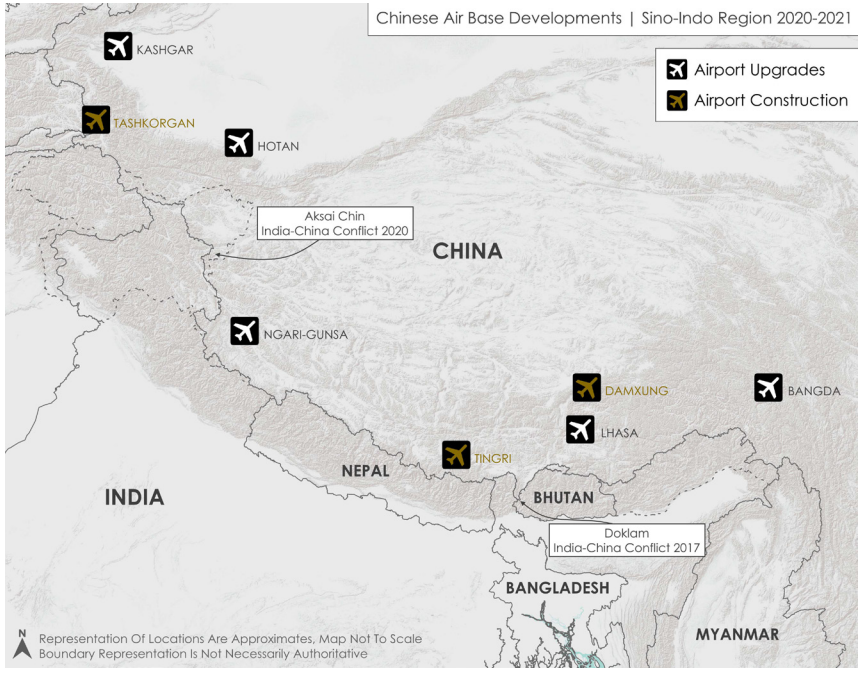
China also attempts to advance its territorial claims on Arunachal Pradesh through an assertive infrastructure-driven policy. The country has long been using such a policy to strengthen its control over Tibet. In recent years, the focus has shifted to the region's remote and impoverished

borderlands. President Xi Jinping outlined this approach during the 12th National People's Congress on 9 March 2013. He declared that "To govern the country well we must first govern the frontiers well, and to govern the frontiers well, we must first ensure stability in Tibet."[92] An assertive infrastructure-driven policy was seen as key to ensuring the security of Tibet's borderlands and consolidating China's position on the Sino-Indian border. That could prove more consequential for China's territorial claims on Arunachal Pradesh than influence operations.

China's Infrastructure Building Tactics

Airbases and Airports

On the military infrastructure front, it was recently reported that since 2017, China has massively expanded its existing airbases and airports in Tibet (Ngari Gunsa Air Base, Lhasa Air Base, and Changdu Bangda Airport) and in Xinjiang (Hotan Air Base and Kashgar Air Base). It included building new runways; new hardened aircraft shelters and underground facilities; new munitions storage facilities; new bases for helicopters, ground forces, and air defense assets; enlargement of maintenance and support areas etc. As regard to its scope, the report observed that "The expansion is breathtaking in its scale and harkens back to the early 2010s in the South China Sea in terms of how fast Beijing is working to shift the strategic reality in the region on its own terms."[93] In addition, China has also constructed entirely new runways in Tibet (Tingri and Damxung near Sikkim and Arunachal Pradesh) and Xinjiang and (Tashkorgan near the country's border with Tajikistan). In the coming years, these airbases and airports could enhance China's military posture and significantly expand the People's Liberation Army Air Force's (PLAAF) combat capability along its border with India.

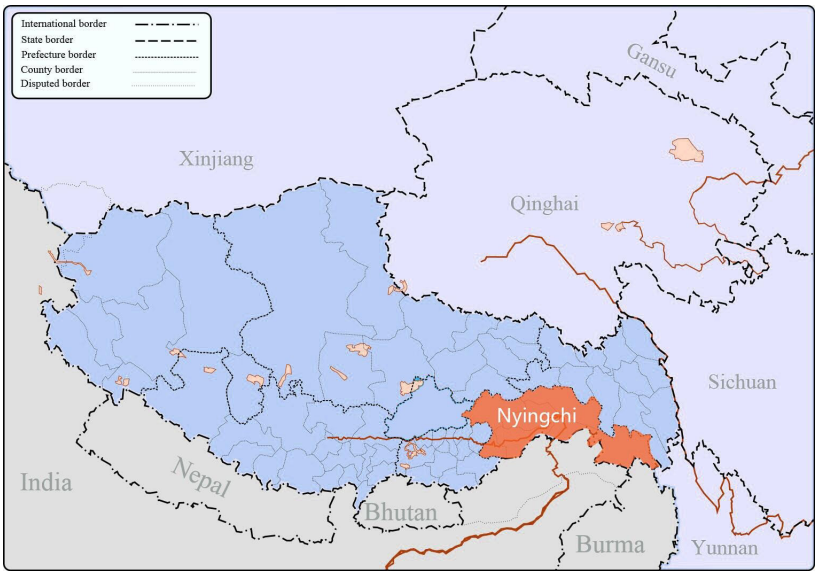


Source: Rogoway, Tyler. 2022.[94]

Road and Railway Networks

In recent years, China has also significantly expanded Tibet's road and railway networks towards the Indian border and Nyingchi Prefecture has become the focal point of this expansion due to its proximity to Arunachal Pradesh. Nyingchi Prefecture is located in southeastern Tibet. It has an area of 117,000 square kilometers and a population of 3.8 million as of 2019.[95] The prefecture is further sub-divided into six counties namely Gongbujiangda, Nang, Milin, Zayu, Bomi, Medog, and one district, Bayi. Bayi Town located in Bayi District serves as the administrative capital of the prefecture. Nyingchi Prefecture is highly strategic. Besides bordering Arunachal Pradesh, part of the Yarlung Tsangpo's middle reaches and all of its lower reaches are located in the prefecture. The status of Nyingchi was elevated to a 'prefectural-level city' on 19 June 2015 and is often referred as Nyingchi City.[96] Because a prefectural-level city is often not a

'city', the use of the term "Nyingchi City" can often create confusion. This paper therefore simply refers to it as Nyingchi Prefecture.



Source: Great Tibet Tour. 2020.[97]

On 31 October 2013, China completed the construction of a 117 kilometers highway that connects Zhamog Township in Bomi County to Baibung Township in Medog County, both located in Nyingchi Prefecture.[98] Baibung, the township where the highway terminated, is located close to the Indian border village of Bishing in Arunachal Pradesh and The Great Bend section of the Yarlung Tsangpo. Some analysts believed that the construction of the highway is linked to China's planned construction of a super dam on that section of the Yarlung Tsangpo. Prior to the construction of the highway, rugged mountain paths, locally known as 'monkey paths', were the only roads into and within Medog County. Seven previous attempts at building a highway in the county since the 1960s have proved unsuccessful due to harsh terrain and weather conditions. Medog County was therefore considered China's 'last isolated county'.[99] The completion of the 117 kilometers highway therefore marks the end of

Medog County's isolation and it could usher in a new era of infrastructure development in this remote but strategic corner of Tibet. On 1 October 2017, China also completed the construction of a 409 kilometer 'high grade' highway that connects Liuwu New District in Lhasa to Bayi Town in Bayi District, the administrative capital of Nyingchi Prefecture.[100] Then on 16 May 2021, a 67.22 kilometers highway that passes over the Yarlung Tsangpo Grand Canyon was completed.[101] The highway connects Pai Town in Milin County to Baibung Town in Medog County.

Then there is the high speed railway line. On 25 June 2021, a 435 kilometers rail line connecting Lhasa with Nyingchi Prefecture entered into service.[102] It is serviced by the Fuxing series of high-speed electric trains that operate at about 160 kilometers per hour. This is part of the 1,838 kilometers Sichuan-Tibet high speed railway line that will eventually link Chengdu, the capital of Sichuan Province, with Lhasa, shortening the travel time between the two cities from 48 hours to 13 hours. Construction has been divided into three sections. The first 140 kilometers Chengdu-Ya'an section in Sichuan Province was opened in December 2018. The 435 kilometers Lhasa-Nyingchi section is the second section to be completed. Work on the final 1,011 kilometers Ya'an-Nyingchi section began in 2020 and is expected to be completed by 2030. When completed, this high speed railway line will become the second railway line into Tibet after the 1,956 kilometers line that connects Xining, capital of Qinghai Province, to Lhasa. That line was operational since 2006. The network of roads and high speed railway line could make the Sino-Indian border more accessible from China's inland provinces. It could enable the quick transportation of military personnel and logistical supplies to the Sino-Indian border and greatly enhance China's combat capability footprint in the area.

Fortifying Border Villages

During the Chinese Communist Party's 12th National People's Congress that was held in 2013, President Xi Jinping declared that "To govern the

country well we must first govern the frontiers well, and to govern the frontiers well, we must first ensure stability in Tibet."[103] This announcement set into motion efforts by China to fortify the Tibetan borderlands. This effort gained a sense of urgency in 2017 following the tense 72-day stand-off between Indian and Chinese troops in Doklam. Following that crisis, the Tibetan government issued the 'Plan of Tibet Autonomous Region on the Construction of Villages of Moderate Prosperity in Border Areas (2017-2020)' in July 2017. The plan called for the establishment of 628 *Xiaokang* or "moderately well-off" villages including 427 first-tier and 201 second-tier villages.[104] These villages are projected to have 62,160 households and 241,835 residents by 2021.[105] Sustaining populations in these border villages requires cheap and abundant supply of electricity. It is highly probable that the supply of electricity came from dams on the Yarlung Tsangpo River and its tributaries. By October 2020, construction of the villages is mostly completed. Regarding its progress, a White Paper issued on 21 May 2021 by the State Council Information Office (SCIO), an administrative office under the State Council, China's chief administrative body, observed that "By the end of 2020, first-tier and second-tier border villages had access to highways, all border townships and towns were connected to the main power grid, and all border villages had access to postal services, mobile communications, and safe drinking water. Through all these efforts in the border areas in Tibet, infrastructure has seen remarkable improvements, all industries are flourishing, and the people enjoy better living and working conditions."[106]

These border villages are built primarily within China's borders. However, some of them have been built inside India. On 18 January 2021, Indian news channel NDTV reported that China has built a new village consisting of more than 101 houses 4.5 kilometers inside Arunachal Pradesh.[107] The village was said to have been built in a disputed area that has been under Chinese control since 1959. Whereas satellite image taken in November 2020 showed neat rows of completed houses, satellite image of the same area taken in August 2019 showed it to be grassland. It is

therefore probable that the houses are built sometime last year. Following this report, India's Ministry of External Affairs (MEA) said in a statement that China has been undertaking such infrastructure construction activity in the past several years and in response, India have also stepped up the construction of border infrastructure such as roads, bridges etc to provide connectivity to the local population along the border.[108] Meanwhile, China's Foreign Ministry spokesperson Hua Chunying refuted claims that the country has built a village inside India on 21 January 2021 by arguing that "China's normal construction on its own territory is entirely a matter of sovereignty."[109]

Source: Fahey, Ryan. 2021.[110]

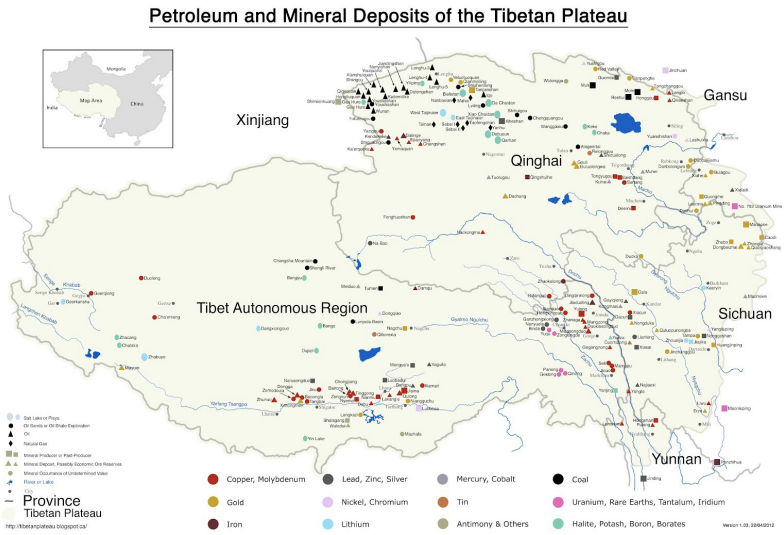
According to Indian analysts, China's construction of a village in Arunachal Pradesh was "designed to create a basis in international law for its territorial claims, which currently lack a sound legal standing."[111] It was also aimed at changing the "status of an area which was previously uninhabited to inhabited with people either from Tibet or mainland China."[112] The village will therefore strengthen China's hand at future border delineation negotiations with India, as the areas it has already developed will not be offered in any land swap arrangement that India may propose involving the disputed regions of Arunachal Pradesh. As

such, China is highly likely to retain sovereignty over the territories in Arunachal Pradesh it already holds. China's construction of a village in Arunachal Pradesh mirrors the country's 'build-it-and-own-it' approach that it adopted in the South China Sea. Since December 2013, China has reclaimed more than 2,900 acres, essentially building islands on top of barren reefs in the Paracel and Spratly chains. This strategy has proved successful so far. Although none of its rival claimants has accepted China's claims, they have not taken meaningful steps to remove the country's new array of landing strips, naval facilities, and surveillance stations.

Mining

One of the major reasons behind China's accelerated construction of dams on the Yarlung Tsangpo River is mining. Mining requires enormous supply of electricity for processing or beneficiation (the removal of worthless particles from pulverized metal ore). At the time of construction of the first dam on the river, the Zangmu Hydropower Station, in Gyaca County in Shannan Prefecture in 2011, one local businessman named Li Hua expressed his optimism that the dam will have major economic impacts on the county and predicted that "Hydropower development will very quickly spur mining, and there'll also be very rapid growth in road and railways."[113] Tibet has rich deposits of minerals including copper, gold, silver, lead, zinc, molybdenum, iron, oil, lithium, chromite, uranium, and gold. As far back as 2010, Chinese geologists claimed to have discovered 102 types of mineral deposits estimated at about USD 100 billion.[114] An analysis of a map of Tibet's petroleum and mineral deposits indicated large concentrations near the Yarlung Tsangpo River. Dams located in close proximity to mineral deposits therefore have enabled what Gabriel Lafitte, author of *Spoiling Tibet: China and Resource Nationalism on the Roof of the World*, referred to as the "fourth stage" of large-scale or industrial-scale mining in Tibet.[115]

Mining close to Arunachal Pradesh in particular could significantly alter China's strategic posture along the Sino-Indian border. The Hong Kong-based *South China Morning Post* reported on 20 May 2018 that Chinese geologists have discovered vast deposits of gold, silver, and other precious minerals valued at nearly USD 60 billion at the remote Lhunze County in Shannan Prefecture.[116] Lhunze County borders Arunachal Pradesh and was once a part of India. It was seized by China during the 1962 Sino-Indian War and is now a Chinese military stronghold. One of the mining sites is Yumei, a town located just 15 kilometers from the border.[117] Yumei has only nine families and 32 inhabitants as of 2017 and was regarded as the least populous town in China. It garnered international attention in 2017 following President Xi Jinping's reply to a letter from two Tibetan sisters from the town in October of that year. The two sisters, Yangzom and Zhoigar, had earlier written to President Xi describing their experiences in safeguarding China's territory and the development that has taken place in Yumei. The fact that President Xi wrote back to the two sisters at all underscored Lhunze County's growing strategic significance. President Xi praised the two sisters for "safeguarding Chinese territory for two consecutive generations" and encouraged them to "motivate more herders to put down roots in the border area."[118] It was hoped that a growing population in Lhunze County would "provide stable, long-term support for any diplomatic or military operations aimed at gradually driving Indian forces out of territory claimed by China."[119] The mining boom in the county promised to do just that. The scale of mining activities in Lhunze County has now surpassed all other areas in Tibet. As a result, the county's population of 30,000 permanent residents as of 2017 has reportedly skyrocketed although precise estimates are unavailable.



Source: Tsering, Tashi. 2012.[120]

Thus, the convergence of dams and large-scale mining poses significant strategic challenges to India. The resultant increase in population and the increase in the number of border villages and road networks could enable China to effortlessly expand into Arunachal Pradesh and strengthen its claims over it.

Options for India

Addressing the Hydrological Implications of Chinese Dams on the Yarlung Tsangpo River

Building Dams on the Brahmaputra River

In light of the recent announcement by China of its plan to build a super dam on the lower reaches of the Yarlung Tsangpo River, there are growing calls in India to build a dam on the Siang River in Arunachal Pradesh also. A statement from the Jal Shakti Ministry that was released on 20 January 2021 observed that "Any attempt to divert water of Brahmaputra

River shall act as an encroachment on the entitled rights of lower riparian states like India, Bangladesh and adversely affect the availability of water in the Brahmaputra basin during the lean season."[121] As such, plans are now underway in Arunachal Pradesh to build a 10 GW hydropower station with a large water storage capacity to offset the potential impact of Chinese dams on the Brahmaputra's water flow.[122]

India's interest in building a dam on the Siang/Brahmaputra River to counteract the potential impact of Chinese dams goes as far back as 2010. Following China's construction of the Zangmu Hydropower Station, the first Chinese dam on the Yarlung Tsangpo River, in Gyaca County in Shannan Prefecture, Jairam Ramesh, India's then minister of environment told *The Guardian*, a British daily newspaper, in April 2010 that "India needs to be more aggressive in pushing ahead hydro projects (on the Brahmaputra)," because "That would put us in better negotiating position (with China)."[123] The reason for India's growing interest in building a dam on the Brahmaputra Rivers is that it could help India establish prior user right on the use of the river's water. Under international law, a country's right over natural resources it shares with other nations becomes stronger if it is already putting them to use. In other words, an upper riparian state has to maintain flow of water adequate for the functioning of an established downstream project. But this may no longer be feasible as China has already operationalised at least two dams on the Yarlung Tsangpo River. The hope therefore is that with India also building a dam on its portion of the river, China will respect India's rights to use the water of the Yarlung Tsangpo River and will not do anything to negatively impact its flow. Secondly, India's proposed dam can act as a large reservoir which can store and release water downstream if Chinese dams impeded the flow of the Yarlung Tsangpo River. Thirdly, it will help India consolidate its position along the Sino-Indian border in Arunachal Pradesh more effectively.

Reducing India's Reliance on Chinese Hydrological Stations

Hydrological measurements are essential for the interpretation of water quality data and for water resource management. India is currently dependent on Chinese hydrological stations in Tibet. However, in light of China's weaponization of hydrological data following the Doklam crisis in 2017, India should explore ways to reduce its dependence on them. Given the fact that the bulk of the Brahmaputra River's flow is generated within India, the possibility of building hydrological stations in the country should be explored. Alternatively, analysts have proposed that India push to amend the existing MoUs on the sharing of hydrological data with China with modifications in the choice of gauging stations.[124] Two locations have been suggested - Gompo Ne which is located at the confluence of the Parlung Tsangpo and Yarlung Tsangpo, about 150 kilometers upstream of Tuting in Arunachal Pradesh and Medog which is located at the confluence of the Chimodro Chu, and the Yarlung Tsangpo, about 50 kilometres upstream of Tuting. These locations are closer to the Indian border and they could provide more accurate and reliable hydrological data.

Establishing Mechanisms to Address Common-Interest Issues

China has in the past spurned India's offer to institute a water commission, an inter-governmental dialogue, or a treaty to deal with water issues between the two countries arguing that existing MoUs were "adequate."[125] Increased melting of glaciers in the Tibetan Plateau and the wider Hindu Kush-Himalaya region due to global warming however has transformed the context for cooperation. The Hindu Kush-Himalaya, which stretches over 3,500 kilometers across eight countries namely Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar, and Pakistan, offer an important geographical framework for co-operation over water resources. A number of Asia's great rivers are dependent on the tens of thousands of glaciers that dotted the region, the bulk of which are located in the Tibetan Plateau.

The Indus River for example depends on glacier melt for over 40 per cent of its flow. The Ganges and the Brahmaputra rivers on the other hand are less dependent on glacier melt although its contribution is still significant at 13.9 per cent and 16.2 per cent respectively.

A landmark report released on 19 February 2015 by more than 200 scientists for the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD), an inter-governmental institution, offered a stark warning: even if the Paris Agreement's goal of limiting global warming to 1.5°C above pre-industrial levels by 2100 is met through rapid cut in global carbon emissions, the Hindu Kush-Himalaya region will still experience more than 2°C of warming.[126] As a result, at least 36 per cent of the region's glaciers will melt. However, if emissions are not reduced, temperature could rise by 5°C and 66 per cent of the glaciers will melt. According to Philippus Wester, lead author of the ICIMOD report, the prospect of large-scale melting of Himalayan glaciers due to global warming is "the climate crisis you haven't heard of."[127] He noted that despite being far more populous, the Hindu Kush-Himalaya region had received far less attention than other places, such as low-lying island states and the Arctic, that are also highly vulnerable to global warming. Another study published by the Columbia University in the United States in June 2019 claimed to present "the clearest picture yet of how fast Himalayan glaciers are melting since 1975, and why."[128] The study, which spanned 40 years of satellite observations from 1975 to 2016 across India, China, Nepal, and Bhutan, observed that on average, the glacier surfaces in the Himalayas have sunk by 22 centimeters (8.7 inches) a year from 1975 to 2000.[129] But this has doubled to 43 centimeters (17 inches) a year from 2000 to 2016. One reason for this is that the Tibetan Plateau, like the other two poles, is warming at a rate up to three times as fast as the global average, by 0.3°C per decade.

The melting of Himalayan glaciers has grave consequences for rivers that relied on its meltwater. At first, it will increase river flows and they are

projected to reach their "peak water" by 2050 through to 2060. After that, the flow will decline as most of the glaciers will have melted away. This will severely affect the water security of downstream countries. The challenges of climate change and glacial melting generate uncertainties which will be hard to respond to without an institution. A scientific institution, perhaps a Himalayan Science Commission (HSC), could offer a way forward. The need for such an institution is underscored by the fact that there is a lack of comprehensive assessments of snow and glaciers and their significance in the overall river hydrology of the Hindu Kush-Himalaya region. Also, there is disagreements, and even confusion, within the scientific community over the probable rate of glacier melting and its potential socio-economic, political, and ecological impacts. For example, the Intergovernmental Panel on Climate Change (IPCC), the United Nation's climate science body, estimated in its fourth "assessment report" in 2007 that glaciers in the Himalayas could disappear by 2035.[130] But that was later found to be "unrealistic"[131] and was retracted. This high profile "error" from the world's top climate science body reinforced the need for more rigorous, collaborative research, and accurate data on glacier melting in the Hindu Kush-Himalaya.

The proposed HSC can help promote such research by providing a regional platform for collaboration among scientists, academics, policy makers, local communities, and research institutions and serve as a knowledge clearing house and a source of technical information on the subject. Most importantly, it can help increase evidence-informed understanding and decision making at all levels of public policy, discourse and action. Countries of the Hindu Kush-Himalaya region have already shown interests in co-operating in this field. For example, India and China had attempted to co-operate on glacial research in 2009 but that has since been deferred.[132] More recently, Afghanistan, Bhutan, India, Nepal, and Pakistan formed the Hindu Kush-Himalaya Glaciers and Mountain Economy Network in 2018 to develop joint strategies to slow down glacier and snowmelt caused by climate change and pollution.[133] The absence of China however left a

gaping hole in the effort. Thus, it is imperative that countries in South Asia band together and engage China through a downstream countries-driven multilateral initiative such as the HSC to mitigate the impact of climate change on Himalayan glaciers. In the course of time, the scope of co-operation could be expanded to include a host of other issues including natural disasters, water sharing, river management, pollution control etc. Viewed this way, the proposed HSC could serve as an important first step towards instituting a basin-wide river management organization that benefits countries that relied on rivers originating from the Hindu Kush-Himalaya in general and the Tibetan Plateau in particular.

Addressing the Strategic Implications of Chinese Dams on the Yarlung Tsangpo River

Strategic Border Roads

For a long time, India has refrained from building roads close to the Sino-Indian border due to concerns that it could fall into the hands of Chinese forces in an event of a conflict and facilitate their rapid advance into the country.[134] This policy was finally reversed in 2006 when India announced a plan to build 73 strategic India-China Border Roads (ICBR) measuring 4,643 kilometers which was later pared down to 3,812 kilometers. The Border Road organization (BRO) was tasked with building 61 of them, measuring 3,323.57 kilometers, by 2012. The remaining 12 ICBRs are entrusted to agencies such as the Central Public Works Department (CPWD) and to states. Of the 61 ICBR entrusted to BRO, 27 roads measuring 1,725.46 kilometers are located in Arunachal Pradesh, 12 roads measuring 1,064.14 kilometers are located in Ladakh, 14 roads measuring 355 kilometers are located in Uttarakhand, five roads measuring 116.99 kilometers are located in Himachal Pradesh, and three roads measuring 61.98 kilometers are located in Sikkim. Delays in acquiring forest/wildlife clearances and land acquisition, lack of availability of construction materials, floods and earthquakes, remoteness of the locations, insurgency

etc. has prevented their timely completion and "only 22 [ICBR] had been completed as late as March 2016 with massive cost overruns."[135]

In light of growing tensions along the Sino-Indian border, the pace of construction has increased in recent years. On 15 March 2021, Defence Minister Rajnath Singh told Rajya Sabha that connectivity has already been achieved on 59 ICBR measuring 3,205.16 kilometers and construction of 42 ICBR measuring 1,530.38 kilometers has already been completed.[136] Besides, in an effort to improve patrolling along the LAC and supplement the main border roads for transportation of troops and material, India has also approved the construction of 18 border patrol tracks measuring 598 kilometers in Arunachal Pradesh in February 2021.[137]

Advance Landing Grounds (ALG)

Since 2013, India has also re-opened a number of ALGs in Arunachal Pradesh. ALGs are airfields in forward location. They enable the quick deployment of forces and equipment to an area of conflict and fulfill the logistical needs of the Indian military. As of September 2019, eight ALGs have been re-opened at Vijaynagar, Aalo, Mechuka, Pasighat, Tawang, Tuting, Walong, and Ziro.[138]

Strategic Rail Lines

To enable the quick transportation of troops and heavy military equipments along the border and also facilitate the overall development of Arunachal Pradesh, India approved the construction of three strategic railway lines into Arunachal Pradesh in December 2015.[139] This includes Bhalukpong-Tenga-Tawang line (378 kilometers), North Lakhimpur-Bame-Aalo-Silapathar line (248 kilometers), and Pasighat-Tezu-Parsuram Kund-Rupai line (227 kilometers). Besides transporting troops and heavy equipment, these railway lines will significantly improve connectivity and contribute towards the state's development.

Border Villages

Infrastructures such as roads, ALGs, and rail lines could measurably strengthen India's military posture in Arunachal Pradesh. Whether or not they will sufficiently deter Chinese expansionism into the state remains to be seen. Deterring China's expansionist pursuit in the state requires more than strategic transportation networks. It also requires improving the socio-economic conditions of border villages. People living in border villages perform critical national security functions. They are often a key source of local intelligence and early warning and they help maintain Indian presence at the border.

There are an estimated 1,555 border villages in Arunachal Pradesh with a combined population of 271,189 people.[140] These villages are located at varying distances from the LAC, with some located just three kilometers away from it. Border villages in the state however are plagued by poor accessibility, inadequate infrastructure, depressed economic growth, poverty, insecurity, and low morale among its inhabitants. As such, there is a sense among border villagers that "their counterparts across the border in China are much better off in terms of both economic and social developments."[141] Such deprivation often resulted in people migrating out of border villages not just in Arunachal Pradesh but also in states like Uttarakhand that also borders China. The *Times of India* reported on 21 July 2020 that "diminishing population in villages along the border with China has been a major concern among the defence forces in Uttarakhand."[142] The report identified at least 16 villages in the state that are located within 5 kilometers aerial distance from the LAC as empty.

The prospect of people moving away from border villages worried officials in Arunachal Pradesh so much so that one of them warned of a "Kargil-like situation" occurring in the state.[143] He reasoned that the lack of people at the border could allow Chinese incursions to go unnoticed. To prevent such situations from arising, greater synergy between strategic

infrastructure projects and ongoing development projects under the Border Area Development Programme (BADP) has to be ensured so that the development effect on border villages and communities are maximized. That would incentivize border communities to stay on in their villages and contribute towards the security of the Sino-Indian border. Besides improving the socio-economic conditions of existing border villages, India should also build new villages at strategic locations along the border. Towards this end, the Arunachal Pradesh government has announced a plan to build three model villages on a pilot basis on 3 March 2021. One village each will be located at the eastern, central, and western part of the state. According to one official, "It is of critical importance that areas near the international border are rapidly developed so that a permanent and patriotic border population acts as a check against any foreign misadventure."[144]

Mining

According to one former Indian geologist, Arunachal Pradesh is a 'land with hidden treasure of mineral resources'[145] on account of its impressive reserves of metallic and non-metallic minerals including coal, oil and natural gas, dolomite, limestone, graphite, lead, and zinc. However, these resources are currently underutilized owing to the lack of systematic exploration and surveys. As a result, the scope of exploitable mineral reserves and their location is not accurately known. Environmental concerns and high cost of transportation also play a role. To facilitate their extraction, India must undertake more rigorous exploration to detect and locate exploitable reserves. And given the increased mining activity in China just across the border from Arunachal Pradesh, India too must make the extraction of minerals in the state a strategic priority. These resources have the potential to rapidly advance the socio-economic conditions of border communities and that outcome will in turn ensure the security of India's borders.

Conclusion

This paper discusses China's hydro-hegemony on the Yarlung Tsangpo River and its potential implications for India. It argued that China exerted a negative/dominative form of hydro-hegemony and this manifested through its unilateral construction of a number of dams on the Yarlung Tsangpo River and its planned diversion of the river's water among other things. The paper further argued that the implications of China's hydro-hegemony extended beyond altering the flow of the Brahmaputra River and into the strategic realm. In other words, Chinese dams in the Yarlung Tsangpo have the potential to advance China's territorial claims on Arunachal Pradesh by facilitating the development of more roads, border villages, and mining close to, and even inside, Arunachal Pradesh. It therefore poses serious strategic and geopolitical risk to India.

India however is not without options. Options for addressing the potential hydrological implications of Chinese dams on the Yarlung Tsangpo River include building dams in Arunachal Pradesh to offset the negative impacts of Chinese dams, building hydrological stations in the state to reduce India's dependence on Chinese ones, and propose the establishment of a Himalayan Science Commission (HSC) to address the common-interest issue of melting Himalayan glaciers due to climate change. Options for addressing the potential strategic implications of Chinese dams on the Yarlung Tsangpo River include building strategic roads, railway lines, airfields etc to facilitate the quick deployment of troops and materials at the border.

Most importantly, India must alleviate the socio-economic conditions of border villages and communities. Thriving border villages are essential for India's security. In the absence of basic infrastructure and economic opportunities, border communities often felt insecure and neglected. That prompted them to migrate out of border villages leaving behind gaping holes in India's border security and defence preparedness. Besides

maximizing the strategic outcomes of its ongoing construction of strategic roads, railways, and airfields in Arunachal Pradesh, India should also strive to maximize their development outcomes. That would increase the incentive for border communities to continue living in border villages and contribute towards the protection of the Indian border from Chinese territorial expansionism.

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