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Geoengineering: Its Implications for India and Neighbourhood

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Abstract

Geoengineering involves intentional alteration of natural environmental systems and has become a strategic instrument, with China emerging as a prominent player. China's large-scale weather modification and water diversion initiatives, especially in Tibetan Plateau present serious challenges for India. These activities threaten to disrupt the flow of trans-boundary rivers like the Brahmaputra and may potentially serve as tool for climate-based coercion. Such developments pose risks to agriculture, civilian populations and military operations in India's border regions. This article examines the strategic implications of China's geoengineering pursuits for India and recommends countermeasures to safeguard national security interests.

Key Words: Geoengineering, Weather Modification, Brahmaputra River, India-China Relations, Climate Warfare, National Security

Introduction

Geoengineering refers to the 'intentional' large scale manipulation of a specific process, central to controlling and channeling the earth's resources, such as those of the oceans, rivers, soil and atmosphere. Geoengineering is defined as "the deliberate large-scale intervention in the Earth's natural systems to counteract climate change" (New Delhi Times, 2021). Various weather modification techniques are available to suitably 'play with' the local climate to suit the needs of the region. Examples include cloud seeding to influence precipitation in drought areas. Started by the United States in 1946, cloud seeding is commonly used in many countries today to overcome drought.

Historical Background

As per a report by Andre Graves titled *Rain making linked to killer flood* (2001), the English village of Lynmouth, Devon was nearly wiped out in 1952 due to secretive cloud seeding conducted by the Royal Air force. This operation was likely part of research looking primarily into possible military applications of cloud seeding, such as flooding the enemy's forces (Dogra,B. 2024).

Around 1956, Soviet engineers started considering the possibility of constructing a dam across the Bering Strait in order to pump water from the Arctic Ocean and release the same into the Pacific Ocean— this would bring warm water from the Atlantic with the goal of eliminating the ice pack, thus making the Arctic Ocean navigable, and warming up Siberia (Weart, S. 2024).

The first confirmed use of weather manipulation, as a meteorological warfare was tried in Vietnam in 1963 wherein weather modification program over Laos (Operation Pop-Eye) was an attempt "to reduce trafficability along infiltration routes"(Hersh, S.M. 1972).

Current Scenario

According to the World Meteorological Organization, more than 50 countries are conducting geoengineering operations. Mexico's Air Force began cloud seeding in the year 2021. Australian universities are dispersing salt spray over the Great Barrier Reef to reflect the sun's heat to conserve the reef (Raczek,T. 2022).

Iran has been accusing Israel of stealing its water through cloud seeding which allegedly reduces rainfall over its territory. Meanwhile, the United Arab Emirates and Saudi Arabia are intensifying their rain-making operations (Raczek,T. 2022). The April 2024 floods in Dubai were attributed initially to cloud seeding. However, it later clarified that the main factor was climate change which caused an intense concentration of heavy rain over a wide area of UAE, Oman and other neighboring countries. Rainfall, that normally spread over 18 months, was concentrated into just one day (Dogra,B. 2024).

As per a report by J. Dean, a blizzard in China was caused or aggravated by country's efforts to induce artificial snowfall (Dogra,B. 2024). China's announcement to develop a large scale weather modification system by 2025 has raised alarm, especially amongst its neighbours. According to a circular of State Councils, "the total area covered by artificial rainfall (snowfall) operation will exceed 5.5 million square kilometres, and for hail suppression will cover more than 580,000 square kilometres". Concerns about military use of geoengineering technology are heightened by the involvement of agencies like China Aerospace Science and Technology Corporation, which is a "major space and defence contractor", in the Tianhe project, which uses advanced military rocket engine technology and satellite network (Jayaram, D. and Bhattacharjee, K. 2020).

The technology can be exploited to create conditions for variety of purposes that can be exploited for strategic implications such as triggering flash floods through cloud seeding to depopulate a region across the border. This article analyses advancements made by China in geoengineering, its ramifications for India and own strategy to counter Chinese efforts.

China's Advances in Geoengineering

China has opened the Beijing Weather Modification Office (BWMO)— a unit of the Beijing Meteorological Bureau, tasked with weather control in Beijing and its surrounding areas including parts of Hebei and Inner Mongolia. BWMO forms a part of China's nationwide weather control effort— believed to be the world's largest; it employs 37,000 people nationwide, who seed clouds by firing rockets and shells loaded with silver iodide. According to Zhang Qiang, head of the Office, cloud seeding increased precipitation in Beijing by about one-eighth in 2004; nationwide, similar efforts added 210 cubic kilometers (7.4×10^{12} cu ft) of rain between 1995 and 2003 (Ruwitch, J. 2004).

Image 1: A cloud seeding rocket is fired in Shijiazhuang, Northern China (May 2021)

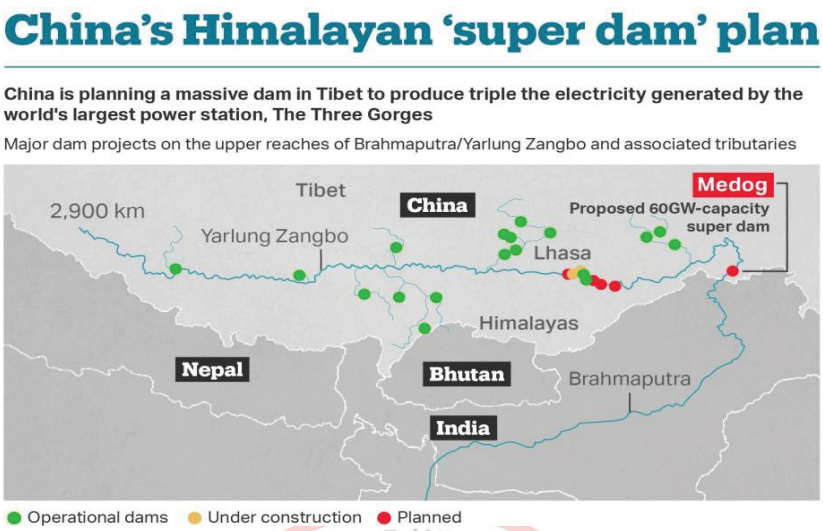
Source: Zhang Haiqiang/VCG via Getty Images

Reports suggest that China plans to build the world's largest cloud seeding system, or in other words, weather modification network, in the Tibetan Plateau, covering an area of 1.6 million square kilometers. This project called *Tianhe* or *The River in the Sky*, is being developed by China Aerospace Science and Technology Corporation. The project aims to use "localized chemical agents" such as silver iodide particles released from the fuel-burning chambers into the atmosphere in order to transfer more water from the Yangtze River basin to the Yellow River basin via water vapour that becomes rainfall. This will increase the rainfall by 10 billion cubic meters annually which amounts to "about 7% of China's total water consumption" (Jayaram, D. and Bhattacharjee, K. 2020).

China had demonstrated the capability of seeding during the Winter Olympics (2022), to disperse storms, unleash rains and engineer a blue sky. BWMO ensured that the 2008 Summer Olympics were free of rain (Guinness World Records,2008) by disintegrating the clouds, headed towards the capital, by means of firing a barrage of 1,104 cutting-edge military rockets into the evening clouds to make the opening ceremony precipitation-free thus diverting the downpour to outlying areas. The office created a snowstorm in November 2009.

China is also involved in large scale diversion of Tibetan waters in its ambitious 'South to North' plan to irrigate its large drought affected North-western areas (Yeh, E.T., 2022). By conservative accounts, China allegedly has plans for around 100 dams to generate hydropower from major rivers rising in Tibet including the Brahmaputra and Mekong rivers (Basu Sharma, V. 2023). China's dam on Yarlung Zangbo at Medog (as mentioned in China's strategic 14th Five-Year Plan, unveiled in March 2021) is expected to produce triple the electricity produced by the Three Gorges — the world's largest power station— and this has left environmentalists in India and abroad deeply worried (Choudhury, R. 2023).

Image 2: Major dam projects on the upper reaches of Brahmaputra/ Yarlung Zangbo and associated tributaries



Source: Stimson/ Britannica

Implications for India and Its Neighbors

Aound 45% of the human population depends on water originating in the Tibetan region. China's intensive damming of the Mekong River has affected millions in Laos, Cambodia, Myanmar and Vietnam because of diversion of their largest source of water.

China's plans for massive weather modification , particularly in the Tibetan Plateau, have set alarm bells ringing in South and Southeast Asia — regions that are dependent on the rivers that originates in Tibet. This could also increase tensions with neighbours such as India.

Image 3: Major rivers originating from Tibet Plateau

Source: https://www.scmp.com/news/china/society/article/2138866/china-needs-more-water-so-its-building-rain-making-network-three

Two main geoengineering techniques have bolstered China's capabilities—weather modification and river water obstruction. According to a statement from China's State Council, the country is committed to bringing about 5.5 million square kilometers of its land area under its weather modification program by 2025. However, the impact of cloud seeding can be seen beyond China's borders, as it may disrupt the normal monsoon in neighboring countries such as India, Myanmar, Vietnam, etc. This would have an adverse impact on the agriculture in these countries, rising potentially to a form of "rain stealing" (Sharma, K. 2023).

China has the advantage of being an upper riparian state for two major transboundary rivers viz. the Brahmaputra and the Mekong. China has constructed many largescale reservoirs on the upper reaches of both rivers, with large capacities for water storage and power generation.

India's Concerns

On 20 January 2024, Defence Minister Rajnath Singh spoke about China "weaponising" weather modification for strategic advantages and emphasised that "climate change in the country is not just a weather related phenomenon, but the matter is related to national security" (Singh, D. 2023). Rajnath Singh expressed concern about certain border states such as Uttarakhand, Himachal Pradesh, Sikkim and Union Territories like Ladakh are experiencing rising frequency of natural disasters. He emphasised that climate change in the country is not solely due to weather related phenomenon; but it is closely related to national security. The Ministry of Defence (MoD) will seek support from friendly countries to study and rule out any potential foreign involvement (Singh, D. 2023).

The National Security Council Secretariat (NSCS) has initiated a project related to weather weaponisation and its "potential exploitation by inimical forces" to study China's strategic capacity. MoD officials are monitoring China's "geo-engineering vision" initiative to shape the weather (Singh, D. 2023).

According to India's Ministry of Water Resources, of the total catchment area of 580,000 sq. km, 50% lies in Tibet, 34% in India and the balance in Bangladesh and Bhutan. Of the 2,880 km of the Brahmaputra's length, 1,625 km lies in Tibet, 918km in India and 337km in Bangladesh. According to the Central Water Commission, 60% of the water in the Brahmaputra comes from India, 40% comes from Tibet (Bhaskar, U. 2013). However, another study on the Brahmaputra River Basin has given out different figures regarding average annual water yield (AWY) in the basin. As per the study, the upper Brahmaputra (Tibetan Plateau) contributes about 20% of the AWY, the middle Brahmaputra (snow and glacier watersheds on the southern Himalayan slope) contributes about 42% of AWY and the lower Brahmaputra contributes about 38% of the AWY (Palash, W., Bajracharya,S.R., et.al, 2023).

Impact on Operations at Strategic Level

Geoengineering has the potential to become a game-changing tool for Beijing's implementation of a hybrid warfare strategy, especially in China's neighborhood. Speculations are ripe that China may use its weather modification technology as a strategic weapon against India to distort weather and unleash floods and droughts, during times of conflict. Such a strategy is not new. Used during the Vietnam War by US by the name of Operation Popeye, the strategy was to increase rainfall during the monsoon season to make the terrain muddy and difficult to traverse for enemy fighters.

The ability to control the water flow gives China a strategic advantage over the lower riparian countries. The sudden flow of large amounts of stored river water has the potential to destabilise the lower riparian countries, impacting their livelihoods and food security.

Traditionally, military operations in Himalayas are significantly dependent on weather conditions. The mountains passes gets blocked during winter months thus severely restricting any large scale movement of troops. However, China's capabilities to alter the weather can cause uncertainty in the military operations dependent on weather conditions which will force Indian side to be prepared even during winter months. Similarly, China may exploit weather modification to sabotage troop movements and logistics operations in border regions by artificially altering the rainy conditions, with an aim to slow down the tactical movement of Indian troops.

Flash floods induced due to geoengineering will be able to cause significant damage to low lying camping sites which are traditionally not exposed to any threat of floods. Therefore, it is essential to identify military camping sites which would not be under threat due to flash floods.

Way Ahead for India

The Department of Science and Technology (DST) under the Ministry of Science and Technology has included geoengineering in its lists of Major R&D Projects (MRDP). The responsibility for spearheading geoengineering research in India has been given to the Centre for Atmospheric and Oceanic Sciences (CAOS) at the Indian Institute of Science (IISc) in Bengaluru, Karnataka. CAOS has since organised a national roundtable on geoengineering titled "Geo-engineering and India: Science and Policy" at IIT Delhi on 23 June 2017 (Khup Hangzo, P.K., 2023).

An important way forward for India is to build on its environmental intelligence capabilities. As any form of decision making would require a holistic view, integration of research across the components of cloud seeding, as well as its interactions with the regions and subsequent ecosystem, is imperative.

To counter what some experts have called a "ticking water bomb for residents downstream (in Arunachal Pradesh and Assam)", plans should be made to build a large barrage — a low-lying structure with gates to control the flow of water, across the Siang river. In case of excess water, barrage should be able to protect inhabitants from the floods. The Ministry of Jal Shakti should lead the construction of requisite number of barrages (in consultation with DST) to minimize impact of dam being constructed by China at Medog.

Given that China is increasingly employing such unconventional means of diplomacy across the region, India should accordingly prepare its respective cadres. In India, the total strength of the India Meteorological Department (IMD) employees is about 6,000, out of which only 300 are scientists tasked to handle different departments like climatology, hydrometeorology, seismology and cyclone forecast (Singh, D. 2023). This strength, when compared to China's 37,000 in BWMO, is very small.

As per a 2002 MoU, China is required to share hydrological information on the Yarlung-Tsangpo/ Brahmaputra between May and October so that downstream India is alerted in case of massive flow during the monsoon season. However, India became wary of China's tendency to withhold information on river status after the 2017 Doklam border standoff wherein China abruptly stopped communicating water flow levels (Basu Sharma, V. 2023).

In so far as the strategic implications of weather modification is concerned, India should ensure that China does not breach the UN's Environmental Modification convention (ENMOD) prohibiting states from 'engaging in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party'. (Jayaram, D. 2019).

Conclusion

China's current and potential use of geoengineering techniques, to manipulate and jeopardize the rules relevant to maintaining the international order, is an issue that cannot be overlooked. The ambiguity in the available data regarding environmental ramifications of China's use of geoengineering techniques hinders the formulation of an effective climate change combat strategy that can be adopted at the regional and global level. Notwithstanding above, the Govt. of India and the Indian Army must develop own counter strategy to negate the impact of Chinese geoengineering projects.

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Colonel Manoj Singh Silot is commissioned into Corps of Signals. Prior to joining the Army, the Officer has done B Tech in Electronics & Telecom from Army Institute of Tech, Pune. The officer has served as Adjutant and Company Commander in his Regimental Service. In staff, he has served as General Staff Officer 1 (Operations) at Force HQ level. He commanded a Mountain Division Signal Regiment. He has also served in UN Peacekeeping mission, MONUSCO, in Democratic Republic of Congo as Chief Logistic Officer. He also participated in Indo-US Joint Exercise which was conducted at Joint Base Lewis, McCord, Seattle, USA. The Officer has been awarded GOC-in-C Commendation Card. He is currently posted in Army Design Bureau at Army HQ and is steering interaction with industry & academia on the niche technologies like Artificial Intelligence, Quantum Technology and Space Domain.