Water Security: Imperative for National Security

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"…… wars of the 21st century will be about water unless we change the way in which we manage it".

—Ismail Serageldin

Former Vice President for Sustainable Development, World Bank[1]

Water have become one of the most valuable resource and vital asset of the country. India has 25 major river basins with several tributaries. Few major rivers like the Ganges, Brahmaputra and Indus are perennial rivers and originates from the Himalayas. The Monsoon rains and Groundwater are other important water sources for drinking, irrigation, industrial use etc. India comprises 1/50th of the world's land, 1/6th of the world population and 1/25th of the world's water resources.[2] However, with changing times and demands, water resources of the country have come under excessive pressure of population, development, pollution, etc.

Climate change have started threatening the world's water systems thereby, altering the water supplies and unsustainable water management practices. According to UN, by 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity and two-thirds of the world's population could be living under water stressed conditions.[3] Water scarcity is among the world's leading problems in the 21st century and has the potential to displace 24 million to 700 million people.[4] As per a study conducted in 2014, five out of twenty world's largest cities, under water stress, falls in India with Delhi being second on the list.[5] Therefore, water can very well become an element of conflict at the domestic and the international level which can have a profound impact on National security. This paper aims to highlight the importance of studying the impact of non-traditional threats like water crisis on National Security Perspective and also explains as to why water security is imperative to National security.

Water Conflict at the National/International Level

Around the world, water sources are depleting leading to an increased possibility of a water conflict. According to the Pacific Institute's chronology, number of water conflicts globally has

risen from roughly 16 in the 1990's to about 73 in the past five years.[6] Water scarcity played a crucial role in the Darfur War (2003) [7]and Lake Chad Basin fighting where the Boko Haram insurgency occurred.[8] Water is also a contributing factor in Syria's current conflict as the Euphrates River water resource is involved in crisis.[9] In northern Brazil, water wars occurred in 2012 after a severe drought situation wherein it reduced water availability.[10]

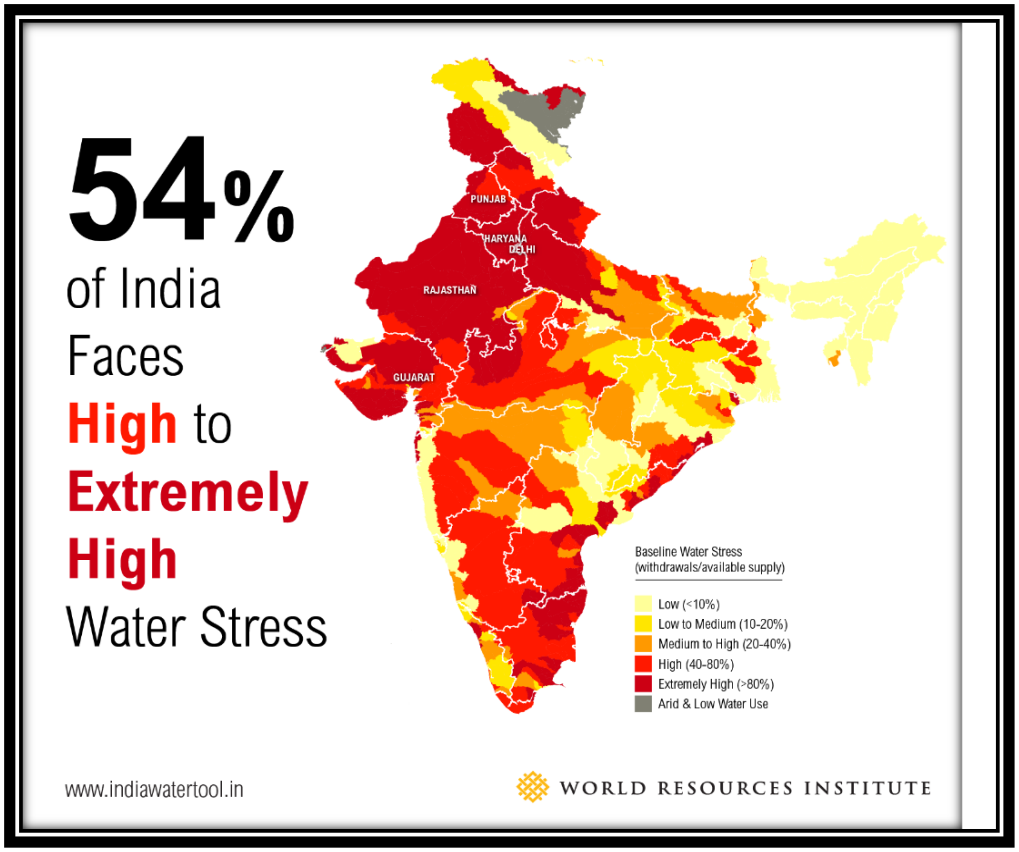
India-Pakistan water dispute with respect to the Indus River was resolved when the Indus Water Treaty was signed in 1960. In 2012, thousands of farmers in Karnataka protested over the release of water from two dams on the Kaveri river to Tamil Nadu.[11] In 2016, as Northern and Central India was suffering from a severe drought, non-availability of water supplies sparked violence in Madhya Pradesh's regions.[12] In 2020, China proposed to build a hydropower project on the Yarlung Tsangpo River (Brahmaputra River); this triggered India-China hydro politics over the Brahmaputra River[13]. Hence, it is clear that Water has the potential to destabilise any region.

Water Scarcity Woes in India

India is home to approximately 17% of the world's population and only four percent of the world's freshwater resources.[14] According to WWF, Ganga is one of the most endangered rivers in the world[15]— Krishna and Narmada have lost around 60% of their flow and Kaveri has lost around 40%[16]; two out of three major Indian cities are facing daily water shortage. About two lakh people in the country die every year due to inadequate water sanitation and hygiene[17] and approximately 820 million people of India, living in twelve river basins across the country, have per capita water availability close to lower than 1000m^3 (Falkenmark index for water scarcity).[18]

In 2016, Godavari, the second largest river in the country which waters three States, turned dry and trickled at its source at Trimbakeshwar.[19] In 2017, South India's five states— Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Telangana, faced severe water crisis. Kerala and Tamil Nadu faced an unprecedented drought and Karnataka's northern district was without sufficient water for three consecutive year.[20] The whole city of Chennai came to a standstill during the Chennai water crisis in 2019 wherein four main reservoirs ran completely dry causing acute water shortage. The map below highlights India's growing water stress.

Figure 1: Map Showing Baseline Water Stress in India[21]



Source: India Water Tool and Water Resources Institute(WRI) 2015

Problems that Affects India's Water Resource

Demography and Urbanisation Pressure

India is witnessing population explosion, as its population has grown from 450 million in 1960 to over 1.3 billion people today.[22] Such an increase is causing pressure on the available water resources. Along with an increase in population, there is a higher rate of urbanisation; India's urban population is expected to reach 600 million by 2030.[23] According to the World Bank, as of 2014, no major city in India was able to supply 24*7 water to its urban population.[24]

Urban hubs are likely to witness severe water shortage in the future thereby affecting urban growth and reducing quality of life of urban citizen in India. The present urbanisation scenario in India is characterised by high-rise buildings, concrete pathways, sewage disposal into water sources and lack of wastewater treatment. These have caused enormous stress on the available water resources and green water sources. Lack of regulation in urban

planning has led to loss of wetlands, blockage of rainwater percolation, and groundwater contamination. The Cooum River's plight in Chennai is an example of water mismanagement that unsustainable way of urban development in India have caused. Cooum, once a clean river, was an integral part of the socio-economic-cultural activity and was even sustainable for navigation. Today, it became the most polluted river due to discharge of sewage and untreated wastewater into the river.

Agricultural Water Foot Print of India

India has been an agriculture based economy; attaining self-sufficiency in food and ensuring food security have been priorities for the Government. The Government has promoted many schemes like dams, canals, and free power supply for irrigation to maximise agricultural production. India's irrigation potential is estimated to be about 140mha of which 76mha would come from surface water and 64mha from groundwater.[25]The quantum of water used for irrigation in the last century comprised 300 km^3 of surface water and 128 km^3 of groundwater, totalling 428 km^3.[26] India ranks second in terms of total water footprint* of consumption (commodity consumption & consumer consumption) right after China.[27]

Cropping pattern in India is one of the reason for water resource scarcity. According to the ICRIER study, water intensive crops like sugarcane and paddy are grown in many States, and uses lakhs of litres of irrigation water per hectare.[28]According to WWF[29], Indian rivers are exposed to sustained pressure from fragmentation and loss of river connectivity that constrain their capacity to flow unimpeded, thereby affecting many fundamental processes and functional characteristic of healthy rivers, leading to the rapid decline of biodiversity and essential ecosystem services.

Groundwater Exploitation and Contamination

Groundwater is an essential source of water for India. According to the Central Groundwater Board (CGWB), groundwater contribution in irrigation is 62% in rural water supply is 85% and 45% in urban water supply.[30] Groundwater played a crucial role in the success of India's Green Revolution. The State of Punjab utilises Groundwater to meet 80% of its paddy irrigation.[31] Power subsidy used mainly to pump water from well, often leads to wastage of water in many states, resulting in depletion of groundwater.[32]

Groundwater is also the primary water source for many industries like textiles and dyeing, beverages, tanning etc. The Plachimada Coca-Cola struggle is a classic example of how industries' unsustainable use of groundwater leads to the depletion of water resources,

The water footprint is a measure of humanity's appropriation of freshwater in volume of water consumed and /or polluted. Waterfootprint.org.

thereby affecting the people's socio-economic environment. Plachimada, is a tribal hamlet in Palakkad district of Kerala, where Hindustan Coca-Cola Beverages Pvt Ltd set up in 1999. The permit to draw 1.5 million litres of water from six borewells, resulted in the reduction of the water table and severely affected the farming activity in which 60%.[33]

Groundwater in India is getting increasingly contaminated, rendering it harmful for human consumption and other economic activities. Many households use Reverse Osmosis (RO) water purifier in the quest to avail clean drinking water. It results in stress on water resources as RO water purifiers wastes around three litres of water to deliver one litre of purified water.[34] India is also facing increasing geogenic contamination like arsenic, fluoride, salinity, nitrate, mercury. According to a report from CGWB:[35]

- Fluoride contamination is widespread in India. Groundwater is affected by fluoride in different parts of India, particularly in Andhra Pradesh , Tamil Nadu, Uttar Pradesh, Gujarat and Rajasthan. About 66 million people in India are consuming water containing fluoride beyond the permissible limit.
- The next critical contamination is arsenic. Arsenic affected aquifers are reported from West Bengal, Bihar, UP, Jharkhand, Haryana, Punjab, Manipur, Assam.
- Iron and manganese contaminations is present in almost all States.
- Salinity has been observed almost in all major aquifer systems. Over pumping of groundwater in coastal areas is causing saline water intrusions. It has been reported in the States of Tamil Nadu, West Bengal, Andhra Pradesh, Orissa, and Gujarat.

A study by The Consultative Group on International Agricultural Research (CGIAR)[36] found contamination of heavy metals such as lead, cadmium, zinc and Mercury in Gujarat, Andhra Pradesh and Haryana. The presence of these contaminants can cause biological and toxicological effects. Pollution, due to untreated industrial effluents, municipal waste, fertilisers and pesticides from agriculture, affects India's quality of groundwater ecosystem. These geogenic and anthropogenic pollution† are causing scarcity in India's fresh groundwater resources.

Blue, Green, Grey and Virtual Water Footprint

'Green Water' refers to the rainwater that percolates in the soil and 'Blue Water' refers to groundwater and surface water. According to a research paper of PNAS, India has largest blue water footprint with 243Gm^3/ year. However, irrigation of wheat takes the largest share of India's blue water footprint, followed by rice and sugarcane.[37] This large footprint explains

†Geogenic pollution refers to naturally occurring elevated concentration of certain elements in Groundwater having negative health effect. Anthropogenic pollution refers to pollution caused by human activities like municipal, industrial waste.

the unsustainable consumption of a limited natural resource and is one reason for water scarcity situation. 'Virtual Water' is the water embodied in the production of a commodity and refer to the water consumed during production. India stands third in virtual water exporters after United States and China.[38] 'Grey Water' refers to the amount of freshwater required to dilute the pollutants caused during commodity production. Out of the total volume of water used in primary crop production, total green water footprint is 479 billion m^3/year and total grey water footprint is 95m^3/year.[39] Grey water footprint is an indicator of freshwater pollution associated with a specific production process like cultivating a crop. Grey water component is highest in the milled rice and wheat.[40]

Deforestation, Climate Change, Desertification

30% of India's land is degraded or faces a threat of desertification[41] due to poor water management. Green water is crucial for vegetation cover. Clearing of forest diminishes tree cover and affects the percolation of green water. Unsustainable policies like concretisation of pathways to make bathing ghats for pilgrims blocks the perennial natural springs. Cutting of trees at the catchment area severely affected the source of the Godavari River leading to its reduced water flow.[42] Deforestation results in soil erosion, landslides and floods. Example being the increasing floods in Jammu and Kashmir.[43] Illegal tree harvesting has reduced the tree cover, affecting the capacity of the tree to hold soil, water and prevent flooding.

Climate change affects the rainfall patterns, and causes a raise in temperature resulting in melting of glacier, floods and droughts. Such temperature rise also causes loss of water due to high evaporation. Reduced water flow or drought can affect inter-state relations in a country like India as is evident from the Cauvery River water dispute between Karnataka, Tamil Nadu, Kerela and Puducherry; the Krishna River water dispute between Maharashtra, Karnataka, and Telangana. Madhya Pradesh and Gujarat went into a dispute in 2017, due to poor rains. The conflict was to the quantity of water to be released from the Indira Sagar reservoir (Madhya Pradesh) to the downstream Sardar Sarovar reservoir in Gujarat.[44]

Springs are the primary source of water for millions of people residing in the mid hills of the Hindu Kush Himalayas. A study found that around 45% of Springs in one catchment area in central Indian Himalayas, have dried up or became seasonal and in another survey it was found that, there is a decline in Spring discharge by 25.75% over the past fifty years—climate change being one of the reason.[45]

Desertification means the continuous degradation of land leading to loss of productive ecosystem and biodiversity. Analysis[46] reveals that 96.40mha area of the country (29.3% of the total geographic area of the country) is undergoing land degradation due to

salinity/alkalinity caused by over exploitation of fresh groundwater because of excess irrigation, evapotranspiration and drought. The 1992 Rio Earth Summit identified 'deforestation, climate change and desertification' as greatest challenges to sustainable development. Illegal and unsustainable sand mining is another reason for depleting water resources. Extensive sand extraction destroys the riverine ecosystem, alters rivers and coastal ecosystem, increases suspended sediments and affects river bed. Sand mining affects the capacity of rivers to rejuvenate & replenish and causes a loss of biodiversity of the river.

Water Security Necessary for National Security

National security comprises a blend of polity, economy, technology, military competence and natural resource availability with an aim to safeguard the Nation State. Food security, economic security, energy security, environmental security, and water resources are the fundamental base to achieve National Security. India, in 2016, faced one of the severe droughts wherein water levels in 91 reservoirs fell to the lowest point in a decade[47] — it caused ripple effects on food security, energy, economy and livelihood.

According to UN Report[48], India will have more than 1.5 billion people by 2030, achieving food security for this rising population along with increasing water scarcity will be a challenging task. Two major staple crops of India vis. wheat and rice, are already facing problems due to water related issues. As primary irrigation sources are dwindling, many agrarian states started facing production challenges. During last few Summers, the Ganges has witnessed an unprecedentedly low water levels in several lower reaches; the dwindling of the Ganges would affect the water available for irrigation thereby threatening food production.[49] With increasing per capita income, preferences for high value crops, dairy and meat products also increases and these products needs higher amount of water for production.[50] Water scarcity impacts food security and health and can cause social unrest and political risk. Hence, effective water management is imperative for country's food security challenge.

Around 40% of India's thermal power plants are located in region facing water stress, which poses operational challenges.[51] Thermal power is India's major source of energy for power generation and commercial activities. By 2030, 70% of India's thermal power plants are likely to face water stress, affecting India's energy production and economic activity.[52] According to a Working Paper of the World Resources Institute, "India lost 14 terawatt-hours of potential thermal generation due to water shortages in 2016, cancelling out more than 20 percent of its growth in total electricity generation from 2015".[53] Water is essential for economic activity and is crucial for industries. According to the World Bank, water scarcity

could cost some regions up to six percent of their GDP.[54] Water scarcity hampers economic growth and triggers migration and violence. Estimates suggest that industrial water requirements will quadruple between 2005 and 2030.[55] Water scarcity will increase the cost of water thereby impacting the industrial production processes. It can adversely affect the Micro, Small and Medium Enterprises (MSMEs) which may cause the industries to operate at reduced capacity, temporary shutdown, curtailment of expansion projects, shedding of workforce, economic hardship etc. In 2016, The Rastriya Ispat Nigam Limited (Visakhapatnam Steel Plant)was forced to operate on reduced capacity due to lower water availability.[56] At its increased capacity, the plant required at least 33 million gallons per day (mgd), but it received only 25 mgd which affected its production capacity adversely.[57]

Water scarcity can affect India's economy through its banking sector. According to NITI Aayog[58], as per RBI, 39% of the portfolio of Indian banks are related to sectors that faces high levels of operational water risk, including agriculture and allied activities, power and basic metal & metal products. Such water risks in bank portfolios can degrade the quality of bank assets, downward revaluations, and rise the total non-performing assets.

According to the World Bank, every dollar invested in water access and sanitation yields an average $ 6.80 in return and lack of implementation of better water management policies could result in regional GDP loss from two to ten percent by 2050.[59]Water shortage in the country can hamper industrial and other economic activity and therefore is a potential hindrance to India's aspiration to be an economic superpower in the near future.

Climate Change and its Impact on the Country's Water Resources

Water security issues along with the threat of climate change can disturb geopolitics and become a potential stress point for politics across nations, example being the India – Bangladesh transboundary river management issues. According to the UN's World Water Development Report 2019, in India, nearly 19 million and 17.5 million people annually were affected by floods and droughts respectively.[60] According to a study published in Earth's Future, climate change could create water stress across international borders. It predicted that, the number of people exposed to water stress would double by 2050 when compared to 2010 i.e. an additional 380 million people could face water stress by mid-century.[61] India ranks 13th among the world's 17 extremely water- stressed countries.[62] According to NITI Aayog, India is suffering from the worst water crisis in its history and millions of lives & livelihoods are under threat.[63]

Social Impact of Water Stress

About two lakh people die every year in India due to inadequate water, sanitation and hygiene.[64] It has been estimated that the demand-supply gap of the water for the domestic sector will stand at approximately 50 Billion Cubic Metres (BCM) in 2030, with the demand expected to double in future.[65] Urban centres and major metropolitan cities are likely to face severe water shortage in the future; it could risk urban growth and affect the quality of life of Indian citizens. Glaring examples of this scenario includes the water crisis in major cities worldwide like Chennai in India, Cape town in South Africa, Sao Paulo in Brazil. According to WRI, more than 100 million people in the country live in areas of poor water quality and 130,600,000 people live in districts where at least one pollutant (surface & groundwater pollutant) exceeded the national safety standards.[66]

Arsenic and fluoride contaminated water have caused millions to live wasted lives in West Bengal, Andhra Pradesh, Telangana, Karnataka and caused socio-economic and psychological fallout.[67] It affects the productive capacity of the people by hindering their physical and mental well-being, affects the standard of lives, and exacerbates poverty and social unrest. Arsenic is carcinogenic and more than a million suffer from Arsenicosis in West Bengal, for which there is no effective treatment. Fluoride can have a genotoxic effect causing dental fluorosis, muscular skeletal fluorosis. Eighty percent of the students at the Government School in Nalgonda district of Andhra suffers from fluorosis.[68] Mercury contaminated water can cause impairment of brain functions, retardation of growth in children, and disruption of the endocrine system. If younger generations are exposed to this contamination, then it will impair next generation's potential and productivity thereby hampering India's demographic advantage.

Water crisis affects women, with the burden being more for rural women. Women are responsible for finding water resources for household purposes like drinking, cooking, sanitation and hygiene. As per reports, women around the world spend around 200 million hours every day, collecting water.[69] Women in villages can end up spending up to four hours a day fetching water to meet the needs[70] and therefore have no time for leisure or for pursuing other activities that are beneficial for their socio-economic progress. For example, last summer, the Betul District (Madhya Pradesh) faced with water crisis because of scanty rainfall. The adolescent girls, residing in the region, were forced to miss school and fetch water for their families.[71] Another reason for low attendance or high dropout rate of girls from schools is lack of water and sanitation facilities. Hence, water scarcity can cause hindrance to India's overall inclusive economic growth.

The Way Forward

Water risks are growing worldwide. Water security can augment India's effort towards food security, poverty eradication, and its commitment to sustainable development goals. There are risk reducing options available to make a country's water management effective. There are legal frameworks adopted by the government to address water challenges, but to ensure a long-term solution, holistic & proactive regulations and effective implementation of these measures are required.

Water mismanagement is one of the reasons for India's water crisis. As of 2015, India treated only 30% of its wastewater.[72] Indian cities lack adequate infrastructure for wastewater treatment and solid waste management, leading to water resource contamination. Segregation of water as black and grey water‡ and mandatory grey water recycling in residential, school, universities, hotels and resorts, can save valuable water resources. The Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) championed the use of treated water (grey and black) for supply to industries, thereby reducing the pressure on freshwater demand.[73]

Another noteworthy example is a school in Kanpur,that treats and reuses grey water for toilet, saving approximately 3000 litres of freshwater every day.[74] Emulating these practices and sharing the best practices among States will scale up water management efforts. According to an estimate from *The Hindu*, an average Indian residing in an urban area, utilises approximately 180 litres of water every day with 25% of it used for toilet flushing. [75] For a family of four, the amount of grey water generated is around 400 litres per day. Treating and reusing this water for gardening and toilet flushing can save 400 litres of freshwater per day per family.[76]

The main impediment to wastewater treatment is the economy involved. Promoting innovative, indigenous low-cost technology can have a dual benefit —water cost efficiency and encouraging research & entrepreneur culture. One such example is the low cost wastewater treatment plant called SHEFROL[77] (Sheet Flow Root Level)§ bioreactor that uses aquatic plants to absorb chemicals, pathogens and micro-organisms from wastewater and then makes the water fit for irrigation purposes. This eco-friendly water treatment plant has been set up at the Chinna Kalapet village, Puducherry since 2014 (patented by Department of biotechnology) and is functioning effectively.[78]

‡Wastewater divided in to two: Black water and Grey water. Black water is any water from toilets or containing harmful chemicals. Grey water is wastewater that has been used for washing, laundering, bathing or showering.
§SHEFROL, an innovative technology designed by Prof S.A. Abbasi, environmental engineer and scientist, from University of Pondicherry. It utilises weedy planta(terrestrial & aquatic) in specially designed & optimised bioreactors which enable sewage treatment as rapidly as is possible only with activated sludge process.

Agriculture and food production is crucial for the nation's food and economic security. Adopting less water intensive agricultural practices is imperative to reduce the stress on water resources. Government is endeavouring to achieve more 'crop per drop of water' concept and is also promoting drip & sprinkler irrigation. Scaling up the micro-irrigation, educating farmers in water management, and promoting organic farming practices & using organic manure will prevent groundwater contamination and river pollution which in turn will protect the land that will result in better yield. To reduce the virtual water footprint of Indian agriculture, NITI Aayog has recommended the development of an agriculture water export index to track virtual water.[79] Development of this index will help better understand the agricultural commodities that leads to water export and thereafter decide on a better policy and incentives to support water sustainability.

Forest and vegetation cover plays crucial role in watershed ecosystem. Trees retain green water that comes from streams and springs. Though, many plantation efforts are carried out by government and NGO's, space availability and cost involved are the main hindrances for scaling up this activity. Plantation technique called "Miyawaki method" proves useful as it is both cost and time effective. In contrast to conventional planting techniques, this method allows the planting of many trees in small spaces wherein the tree grows faster and are free of chemicals and fertilizers.[80] Government's plantation drive incorporating efficient planting techniques and supporting NGO that involves in effective plantation method can scale up the plantation drive. It is also necessary to have a practical regulatory framework for preventing deforestation in upstream areas, reserve forest areas and punitive measures for illegal timbering.

Constitutional and institutional ambiguity in inter-state river water dispute poses challenges to effective water governance and inter-state peace. Increasing water scarcity, rapid rise in urban and rural demands for freshwater, contentious political dynamics, flawed economic instrument for food security and lack of an integrated ecosystem approach exacerbated this problem. The Inter-State River Water Disputes (Amendment) Bill 2019, and the River Basin Management Bill (2018) are two major impending legislations that seeks to reform and refurbish the interstate river water governance in India.[81]Passing this legislation and effective implementation can be an essential step towards sustained deliberation on inter-state river water dispute.

India and its neighbouring countries share transboundary rivers, but transboundary water management has remained weak.[82] As demand for water increases and water supply dwindles, the riparian countries are extremely vulnerable to conflict, thereby threatening national security. The effective management of transboundary water resources involving

basin-wide planning and management, would ensure minimum environmental flow and joint management of water storage structures.[83]

River ecosystem is vital for the rejuvenation and revitalisation of the river. Illegal sand mining, rapid urban growth with lack of planning, and river bed encroachment, affects the river ecosystem. India ranks second in the world's sand consumption.[84] Stripping rivers of the sand causes water tables to drop, erodes river deltas, and affects the ecosystem that has a symbiotic relationship with the river. Government's water management plans and programmes needs to be flexible to incorporate regional diversity, ecosystem and environmental contingencies.

Granular mapping[85] of each State for aquifer system, spring locations, and river systems, helps deepen the understanding of the landscape & topography with an aim to monitor water depletion and contamination. Data sharing with the State Governments and relevant research institutions can scale up the larger goal of scientific management of water systems and sustainability. With the government planning to roll out the *'Jal Jeevan Mission'* (JJM) that aims to provide Functional Household Tap Connection for every rural household, leveraging hydrological mapping of the regions can help in better understanding the supply-demand gap and which in turn can benefit the mission's aim to provide quality drinking water.

Water is vital for all living beings on earth. Ensuring water security is not the domain of the government alone. People's participation, change of perspective and conscious living, will ensure success to protect this life sustaining resource. In this regard, Uttarakhand High Court's judgement declaring Ganga and Yamuna rivers as living entities, giving them legal rights as a person—a move that could help in efforts to clean the pollution is worth mentioning and emulating.[86] In Indian tradition and culture, water is treated with reverence, but the plastic oriented lifestyle and population pressure have affected our rivers. Plastic bags, plastic bottles, sanitary napkins, packaging materials, etc. are choking our water systems. Making a conscious choice to avoid plastic carry bags, plastic products and bringing about a change in lifestyle like preferring cloth/bio-degradable products and diapers, can go a long way in sustaining water and its ecosystem. Adopting proactive water efficacy practices, regulations, legislations and effective implementations, spreading awareness among citizens and educating the younger generations on water management, can ensure sustainable water management to achieve water security.

India aspires to be a super power and is an emerging economy, therefore water security is essential for the country to be self-reliant— a necessary aspect of Sovereignty. The national security foundations—food, economy, energy and environment security depends on the

availability of water resources. In this era of an interconnected and globalised world, national security has to be seen more holistically and comprehensively. Non-traditional threat like the water crisis can help strengthen India's security in relation to its peers.

End Notes

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