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Combating India's Water Crisis: Lessons from the Chinese Example

Abstract

As India attempts to embark on an ambitious economic growth trajectory, the newly created water ministry will be unable to combat the country's increasing water stress if water security is dealt with in isolation. Water is not only about a resource for consumption or agricultural and industrial use but also about the health of the people, long term environment and ecological welfare of the nation and is closely tied to the economy of the country. While we put into place numerous measures to combat our water stress, it is only beneficial that we consider all examples and experiences from around the world, including those from China that has begun these battles and has had a few successes we might learn from.

Keywords*: China, India, Water Stress, Water Pollution, Flood, Drought, Climate Change*

State of Water Resources in India and China

The conversation on water security is fast gaining traction in India; especially given the protracted drought over the last few years and stress faced in rural areas as well as several urban centres around the country. The launch and establishment of the new Jal Shakti Ministry indicates a more serious commitment from the government than ever before. However, the present conversation is largely around solving the immediate water crisis, with a greater focus on the supply side of the issue. Moving forward, it is critical that we take a more comprehensive long term approach; putting into place policies that detail effective management, manage growing demand, balance urban and agricultural needs, and use technology to plug in gaps in distribution and water waste (accounting to over 60 per cent in some areas) across the country. There is scope for the private sector to play a greater role and the government to create the space and opportunities for multinational investment, funds and domestic operators to work in tandem with governance.

Several countries around the world, facing similar water problems, offer better practices, innovative examples and technology that can be adapted in an India context. These include Singapore, Israel, the European Water Framework Directive amongst others and to a certain extent China. China has had to deal with similar development challenges as India; issues ranging from a large growing population, over exploitation, excessive demand and fast paced economic and industrial development that relate more to the developing country narrative. Studying the successes as well as failures could provide insights and learnings for India as we embark on a similar journey of high growth expectation with limited water resourc-

es. The aim of this paper therefore is to consider a few key policies and changes instituted by China over the last couple of decades, that could provide important learnings for the Indian context.

China's Water Resources

Water is an important fuel for industrialization and growth. China's drive to improve water quality and management largely stems from the threat posed to the country's ambitions for economic growth and progress. The Bank of China's 'Report on Economic and Financial Outlook for 2020' has projected an annual growth rate of 6.1 per cent. However, while the country's economy has grown eight-fold since the mid-1990s, water consumption has increased close to 1 per cent annually. Overall, there are two basic aspects to China's water problem. The first is a distribution problem. For example, although China has the 5th largest reserve of freshwater in the world, the lesser populated southwest gets 25,000 cubic meters per person per year, while the more densely populated north gets under 500 cubic meters per person per year. Some of the fast-growing cities of Beijing and Tianjin, industrial areas, coal basins as well as agricultural areas of water intensive crops are in the north, which has increased the stress on groundwater, leading to a drop-in water tables (approximately one meter every year since the 1970s) in the North China Plain. In order to address this issue, one of the biggest steps undertaken by China is the South-North Water Transfer Project (SNWTP), which aims to divert water from central and southwest China to the Yellow River that supplies water to the Beijing-Tianjin region (Brookings 2013). This project has generated much debate in the ecological circles, and while important and necessary, is not the scope of this paper. What we will consider however, is the strengthening of some of the internal water mechanisms that China has implemented to manage existing supplies and attempts to balance growing water stress with demand and growth.

The second aspect to China's water resources problem is that of quality. China's waters have been exploited to the extent that the ecological flow has deteriorated in places, reducing the self-cleaning capacity of the water systems (SIWI Report 2017). At least 70 per cent of lakes and rivers in China are polluted, and more than half are extremely polluted and unfit for human use. The Yangtze River, China's largest and the world's third-largest river, is inundated with sewage and industrial refuge. This could be potentially disastrous as this river is a major resource for Beijing and also supports 242 coal power and 600 hydropower plants (Fortune 2019). The state of surface water is also poor and recognising this China began to incorporate measures from the 1990s to monitor the quality of the resources and create measures to control the pollution levels. Though the situation as of 2017 (based on available research) was still found to be dire, with a third of the water resources rendered unfit for human consumption and several rivers and water bodies not meeting targets, investment in this space has increased. As of the 2019 government budget, spending in water and soil pollution was increased by 45.3 per cent and 42.9 per cent, reaching RMB 30 billion and RMB 5 billion respectively (The Straits Times 2019).

India's Water Resources

India is not a water deficit country, but severe neglect and lack of monitoring of water resources coupled with unchecked development projects has resulted in several regions in the country experience water stress on a regular basis. In our quest for greater growth rates, we have until recently ignored the warning bells on the state of our water resources. Over 600 million Indians face a high to extreme water stress situation according to a 2018 report by NITI Aayog - the government's policy making and research body (NITI Aayog 2018). The report also states that 21 Indian cities are expected to run out of groundwater in 2020, affecting over a 100 million people. India ranks 13th out of the 17 countries facing extremely high water stress, on the 2019 Aqueduct Water Risk Atlas released by the World Resources Institute (World Resources Institute 2019). The demand for water is expected to double over the next decade, resulting in severe scarcity for hundreds of millions of people, a snapshot of which the country has already experienced over the last few years.

India's challenge with regards to water has been lack of adequate access, misallocation, poor and outdated management and abysmal conservation of existing resources including excessive pollution. The Central Water Commission data shows that on an average over 80 per cent of available groundwater has been withdrawn across the country though there are huge gaps in data leading to further mismanagement and poor judgement. The water table has been dipping by 0.4m annually with coastal areas experiencing heavy sea water intrusion making water consumption untenable and fertile arable land unfit for cultivation. A slow approach to modernization is one of the challenges that further exacerbated water distress: for example, in many parts of India, farmers have traditionally practiced flow irrigation, resulting in huge wastage of water, while causing severe soil erosion, leaching of fertilizers, increasing the infestation of pests, diseases and weeds and suppressing the crop yields. Relentless urbanization and industrial growth are also major contributing factors to the poor state of water resources, especially in urban and peri-urban areas. Concretization of important marshlands and clogged sewage lines has resulted in floods and other human precipitated disasters. With unchecked urban development and extraction of groundwater, cities are unable to counter and deal with drought or delayed rainfall, as was witnessed in 2019 that saw over 40 per cent of the country affected.

Rivers and water bodies that were once lifelines of important economic hubs in the country, such as Delhi, Mumbai and Bangalore, have dried up or have been rendered unfit for consumption leading to a decline in economic growth activity. Mumbai has lost over 25 per cent of water bodies/water due to urbanization, while Bangalore has lost 79 per cent. Delhi for example depends on neighbouring states of Haryana and Uttar Pradesh for its water, where over 60 per cent comes from Haryana, a state that is already water stressed. The government has launched an ambitious water welfare programme through the Jal Shakti Ministry which at the foremost aims to increase the access of water across the country, and while access is important it doesn't speak to the need for long term management of our water

bodies, curbing demand and waste and sustainable water use practices.

Key Learnings from the Chinese Experience

Urbanization and industrialization, in line with the government's ambitious economic plans are two of the main causes of the water stress. However, at the national and local levels several actions have been taken to promote water efficient practices and put into practice measures that work towards cleaning up existing water bodies and bringing them back to life. There is no doubt that improving China's water stress situation has a long way to go. Yet India, which faces many similar problems and is also on a path for fast track economic growth and development, can gain from their many experiences and trials, for the adoption of successful policies and measures into its own ambitious water management practice.

Water Pollution

The Chinese government has invested both attention and resources towards improving the quality of water, an issue that has been on their national agenda since the 1990s: the 9th Five-year Plan (1996-2000) looked to improve key drainage basins; The 11th and 12th Five-year Plans (2006-2015) brought focus to pollution control. The government introduced Comprehensive Plans for the Yangtze River Basin (2012–2030) as well as put in place systems to standardise measures through a "unified water volume regulation and management system" (China Daily 2018).

There has also been considerable monetary investment from the government towards clean-up efforts: in 2014 Premier Li Keqiang set aside USD 330 billion to tackle water pollution (Reuters 2014). In April 2015 the State Council introduced the Water Pollution Prevention and Control Action Plan, aimed to enforce stricter standards, increase monitoring, strengthen law enforcement, reduce water consumption by 23 per cent from 2015 levels by 2020, upgrade urban sewage facilities, and increase rates of wastewater treatment. It also demands reduced contamination from agricultural pollutants, by lowering the use of chemical fertilisers and insecticides. In 2016 the 13th Five Year Plan set specific goals[1] for water consumption and water quality.

A study by the Chinese Academy of Science's Institute of Geographic Sciences and Natural Resources Research has found an improvement in surface water quality from 2003 to 2017: with a 63 per cent drop in Chemical oxygen demand, and 78 per cent drop in ammonium nitrogen levels (South China Morning Post 2020). An

[1] Maintaining the previously set reduction targets for chemical oxygen demand and ammonia nitrogen, it established higher targets to improve quality of surface water through the Action Plan on Water Pollution Prevention and Control. The plan sets a 23 per cent binding reduction target in water consumption per 10,000 RMB of GDP by 2020, and a higher water consumption cap of 670 billion cubic meters (US-Chine Economic and Security Review Commission 2017).

improvement in quality was also observed between 2001 to 2014, in seven key river basins- Yangtze River, Yellow River, Pearl River, Songhuajiang River, Huai River, Hai River, and Liao River (SIWI Report 2017).

Methods and Implementation

Water Pollution Prevention and Control Action Plan

The 2015 Water Pollution Prevention and Control Action Plan was a watershed moment for goal setting and implementation methods adopted by the Chinese authorities. This was the first comprehensive plan, integrating all previous efforts, to tackle water pollution. The plan set mid-term and long-term actions and objectives for the government, enterprises, and the public: the first set being for 2020, next for 2030 and finally for 2050. Specific performance indicators were set, with definite goals and timelines. For example, the plan states that by 2020, 70 per cent of the water in the major watersheds and 93 per cent of the drinking water sources in major cities are to meet Grade III or higher standards. The water resources mentioned (drinking, surface, ground and offshore areas) also include the environment and ecology impact, and consider pollution from industries, agriculture, urban areas, and transport (SIWI Report, 2017). As of 2019 the levels of urban "black and odorous water" were at 17 per cent (targets for 2020 are 10 per cent). In 2018 the Ministry of Ecology and Environment (MEE) found 71 per cent of 1,940 samples tested across China to be grade III or better - a 3.1 per cent improvement from 2017 levels. There was also a fall in amount of "below grade V" water by 1.6 per cent points in 2018. However, results are not uniform, for example while water levels may have improved in the Yellow, Huai, Yangtze and Pearl rivers, they have worsened in areas such as Liao and Songhua from 2017 to 2018 (Reuters 2019).

River Chiefs and Commissions

"River Chiefs" have been appointed throughout the country to protect rivers and lakes (by controlling and preventing pollution as well as restoring the local ecology), and to increase the accountability of local officials on the issue of water quality. The first appointment of a river chief was made in Jiangsu about a decade ago to tackle the problem of a blue-green algae bloom. Today, large rivers and lakes have multiple river chiefs who are accountable for any damage to the rivers under their oversight; their performance as a river chief is taken into consideration for overall performance evaluation. In order to increase transparency regarding the work of river chiefs, their names and responsibilities are made public. This system has brought Improvements to water quality in the Yangtze River Delta; according to the Greenpeace East Asia campaigner Deng Tingting, there was an increase in the proportion of surface water categorised as 'fit for human use' (grades one to three) from 35.5 per cent in 2011 to 63.9 per cent in 2016 in Jiangsu. By 2018 there were around 300,000 river chiefs appointed around China (International Rivers 2018).

The setting up of river commissions has played an important role in the clean-up

efforts for river systems, as seen in global shared transboundary river basins. Interestingly, these commissions for seven major rivers basins disregard internal political boundaries and instead look at the entire river basin to ensure balanced development and use of water within the basin. The Changjiang Water Resources Commission (CWRC) looks to the Yangtze River valley, which produces one-third of the country's food and accounts for over a third of the GDP. Rapid economic development increased stress on this river, bringing the need for its protection all the more vital. Thus, on the Yangtze, the CWRC under the Ministry of Water Resources, along with relevant provincial departments carried out a series of "physical examinations" to check the health of the river; based on these tests, the program for the protection and rehabilitation of the Yangtze River valley's ecological environment and the three-year action plan (2018-20) were developed. Similarly, the Yellow River Conservancy Commission ensures enforcement of water related laws and has the power to draft policies, most importantly, at the basin wide level and develop and implement plans for flood control, soil erosion and other taking a macro view and perspective of the entire basin. The Commissions control centre in Zhengzhou closely monitors dam and discharge pipes to control the rationing of water to farms and industry, using modern remote sensing technology to collect real time data (Financial Times 2014).

Support from Leadership

The country's leadership appears to be invested in driving the momentum on water issues for a variety of reasons. In a 2016 meeting President Xi Jinping prioritized the rehabilitation of the Yangtze River's ecological environment, limiting extensive development along the belt (China Daily 2018). As a result water conservancy departments have focused on strengthening the ecology of the valley through water allocation projects, and adjusting river-lake relations. The number of reservoirs included in the joint operation of the upper and middle reaches of the river increased from 10 in 2012 to 40 in 2018, preventing floods in 2012, 2016 and 2017 from causing extreme devastation. In addition, the reservoirs have boosted power generation, water supply and ecological protection, though some of the reservoirs have come under criticism from an environmental perspective. Concrete measures have also been taken to strengthen approval, supervision and management for the use of river and lake shorelines in the valley.

In 2017 China also updated its Water Pollution Prevention and Control Law, for the first time since 1984. The revision increased accountability at the provincial level by shifting the focus from reducing/ managing pollutants to meeting specific quality targets (South China Morning Post 2017). In addition, the water quality targets are now included with GDP and employment as performance evaluation criteria for local officials. The professional growth of these officials will thus partly depend on their ability to meet water quality targets, which provides an incentive and impetus to officials for working towards meeting those targets. The Central Government is looking to integrate industrial policy into the planning system of coal use and other toxics. The overall aim is to generate clear guidelines on industrial restriction in EFZs. These restrictions will be a negative list for industry access.

Ultimately China wants to develop circular economy practices to reduce pollutant discharge and foster clean production standards in papermaking, printing and dyeing, chemical, building material, and tanning industries (State Key Laboratory of Urban and Regional Ecology 2018).

Systems of Information Sharing

Greater data and transparency is a cornerstone on improving the quality of water available to the country. Actions taken by the Chinese government signify an acknowledgement of the need for systems of information sharing. In 2014, the Law on Environmental Protection was modified to strengthen mechanisms for the release of data, following which the Ministry of Environmental Protection began to use citizen participation as a means of improving environmental monitoring and governance. In 2017, for the first time, the Ministry of Environmental Protection released to the public, data on the state of China's water quality from measuring points across the country, a big step towards transparency for China (South China Morning Post 2017). A national groundwater monitoring project was also completed, with data provided by the Ministry of Water Resources and available in the above mentioned report. This data is being used as a basis to consider policy making to manage ground water across different provinces. Similar data is also available on the air quality, coastal regions, state of monitoring networks for drinking water, marine water environment and other areas.

Economic Incentives

Economic incentives include systems where new industrial users pay for new improved irrigation systems, that then allow excess agricultural water to be diverted and keep the demand of water constant. For example, new industrial users in the region of Ningxia, pay the Ningxia Water Bureau, which uses the funds for projects such as lining irrigation channels with concrete to stem seepage (Financial Times 2014). The Baotou Iron and Steel Company plant in Inner Mongolia (one of the world's largest), recycles 98 per cent of its water, a requirement of a 1997 law that requires owners of industrial plants to conserve water, as the region receives very little rainfall through the year (Circle of Blue 2011). The Inner Mongolia Autonomous Region is leading a new national policy to bring about investment in efficient irrigation practices in an attempt to bridge the gap between rapidly developing local industries and the region's growing water insecurity.

China's 12th (2011-15) and 13th (2016-20) Five-Year plans specifically refer to the development and application of eco-compensation in order to achieve an ecological civilization. Eco-compensation is a popular market based method to tackle pollution by providing compensation, through policies that either give monetary relief or support implementation of sustainable practices, to suppliers of 'ecosystem services' for lost income (World Resources Institute 2012). In China, eco-compensation features in the 2002 Water Law, that attempted to establish a strict licensing regime whereby virtually all water resources were declared to be the property of the state, and water use was made contingent on obtaining a usage license from local authorities (Brookings 2013).

Urban Water Solutions

Sponge Cities

Two thirds of China's population live in urban areas/urban water supply catchments (Nature 2016). To address the problem of a growing populations dependence on limited water resources at a larger scale, the Chinese government launched the sponge cities project in 2015 identifying pilot 'sponge' projects in cities which are given 400 - 600 million yuan each year for three consecutive years, to improve water quality, management, as well as make cities more sustainable over all. The central government has offered subsidies planned up to this year (2020) after which, local governments will need to involve local players (The Guardian 2019). Buildings in sponge cities are covered with "green" roofs that capture and filter run-off water, which can then be recycled through aquifers, and used for gardens, or domestically to flush toilets and clean homes. Wuhan (capital of Hubei province) is an example of a sponge city, traditionally prone to floods, that has successfully retrofitted 38.5 sq. km (costing 11 billion yuan as of 2019) with features that improve climate resilience - permeable pavements, gardens, that allow the rain water to permeate through the soil to underground storage facilities with controlled discharge into the river (The Guardian 2019).

China has also plans to construct Liuzhou's forest city (construction is expected to begin this year -2020), on the banks of the Liu River, around 255 km from Nanning. This city has been planned with the aim to have 40,000 trees and almost one million plants on its buildings. Through this the city is expected to produce 900 tons of oxygen and absorb almost 10,000 tons of carbon dioxide and 57 tons of pollutants per year (Thomas Reuters Foundation 2017).

Infrastructure Development

In urban areas, the larger infrastructure outside of water, including sewage and waste disposal are an important determinant of quality. In major cities, including Beijing, efforts have been made to improve these issues: for example, since 1998 China has focused on wastewater treatment, with further support through the 11th and 12th five-year plans. Over the last few years the city has rolled out a set of measures to improve water quality of major drinking water sources and is planning to build ecological protection zones for the Chaohe and Baihe Rivers that feed the reservoirs that provide drinking water to the city. According to data released by the Beijing Water Authority, by the end of 2018, Beijing had completed the major construction of 15 recycled water factories, utilizing 1.07 billion cubic meters of renewable water. The recycled water has served as a stable source for multiple uses for industrial production, municipal services, as well as a water and lake supplement (China Daily 2019).

In Shanghai, a partnership with the World Bank from the early 1980s has led to greater adoption of green infrastructure with a focus on improving sewage networks. In 1987 the Shanghai Sewage Project (worth USD 153 million) was

launched, in cooperation with the World Bank, to build the infrastructure for improving water quality, treating wastewater and managing sewage (World Bank 2018). For the first time China also began to collect tariffs from residents and the private sector for this purpose. Further the first water authority, the Shanghai Municipal Water Authority, was established to support the city municipal government's efforts to bring structure to the sector and improve governance (World Bank 2018). An important mandate of the water authority, as mentioned on their website, is 'to take charge of the management and protection of the water resources', which also includes ocean management.

Adoption of Technology for Non-Point Source Treatment

The Mega-cities and their watersheds project under the EU funded, EU – China Environmental Sustainability Programme (ESP) (2013-16), has been particularly significant in changing the approach towards drinking water pollution from point source treatment to non-point source treatment. While the former is the traditional approach to improving the quality of drinking water, the latter is the most difficult to control as it is at times difficult to track water pollution from fertilizers of household waste discharge in rural areas, which effect the health of watersheds in the whole country (SIWI Report 2017). The program allowed for a transfer and adoption of European nature-based solutions and learnings to the Chinese context; first piloted in the Miyun (Beijing) and Jiaquan (Guangdong) watersheds to restore ecology and control non-point source pollution. For example, in Miyun a three-level buffer zone was created to control the seepage of agricultural chemicals into the river system.

In the Jiaquan River Basin ecological agriculture – fertilizer free cropping of vegetables and rice - was promoted, which improved quality of the crop, increased revenue and return due to improvements in quality of soil. The lessons learned were shared with cities through establishing a Partnership for Mega-city Watershed Protection (PMWP) (SIWI Report 2017). New guidelines were developed, based on the results of the pilot project, to control non-point pollution that enter watersheds from rural areas. These guidelines include maintaining river buffer zones, importance of artificial wetlands, ecological agriculture and fertilizer management (SIWI Report 2017). In order to achieve this, over 500 farmers were trained on best practices, and community-based mechanisms.

Lessons for India

The Water Economy Cycle

The quality of a water body or river system greatly impacts economic output and growth, to which India has recently started paying more attention, however, action on this has been sluggish. Rivers are still being used to dump waste - the Central Pollution Control Board estimates that 63 percent of the urban sewage flows into rivers. Although some water treatment and sewage treatments projects are underway along river banks, the efforts need to be on a much larger scale,

targeting both industrial pollution as well as urban sewage management. One of the ways to do this is to consider the river or water body as an entire unit, and not a sum of its parts and thus focus on monitoring pollution as a whole. Setting up river commissions and river chiefs to aid in this process, similar to methods set up in China could work in this direction. The heavily polluted Yellow River serves as good example; the Yellow River Conservancy Commission played an important role in the clean-up efforts and was pivotal in saving the river. The Wuxi river chiefs also made drastic water quality improvements, with rivers and lakes hitting a 71 per cent water quality compliance rate within a year (New Security Beat 2019).

The advent of the 'Swachch Bharat' mission, launched in 2014 has made strides in this direction, with effective communication between centre and state and greater buy-in from all stakeholders. The mission has seen change at various levels, driven largely by leadership at the highest levels. While the 'Jal se Nal' campaign has been drawn along similar lines, there needs to be stricter measures and enforcement of targets, more effective use of technology and the concept of a river commission that goes beyond district and state lines. The Water Pollution and Control Act of 1974 and The Water Prevention and Control of Pollution Cess Act of 2003 need to be updated with better enforcement mechanisms.

The concept of drawing red lines or setting up water quality targets that are linked to economic incentives and penalties can be re-imagined in the Indian context. For example, during previous Chinese five year plans, three "red lines" were declared, with targets set for 2015, 2020, and 2030 to cover maximum total water use, efficiency of water use and pollution control. At the moment, advocacy on pollution control is largely driven by the social sector, however, there is a business case for cleaning up our waters and therefore scope for greater public private partnerships. For the Yangtze river, which is a lifeline for 175 cities including Beijing, which generate a combined GDP greater than Canada and Japan, the Chinese authorities combined public and private funds for investments in projects worth USD 2.1 trillion. The Ministry of Environment reported an overall improvement in water quality, which is graded in banks, from 2015 to 2017, where over 40 per cent of sites identified had completed treatment projects. In 2017, China made further investments (USD 100 billion) to meet plan targets, through the launch of around 8000 water clean-up projects, covering the 325 contaminated groundwater sites identified across the country as part of the 2015 action plan. (Reuters 2017).

Another water related aspect that has direct impact on India's economy is the disruption caused in major cities from natural events that are exacerbated through human mismanagement. A prime example of this is the extreme flooding caused by monsoons, as was seen in Kochi, Mumbai and other coastal cities in 2018-19, as well as in Assam and Bihar. The impact to Kerala was amongst the highest with 324 people dying, over 80 dams destroyed and damage amounting to over USD 2.8 billion. The overall damage to the country was estimated to be over USD 37 billion (Germanwatch 2019). While higher levels of precipitation is attributed to changes in the climate and flooding is an annual natural phenomenon, disproportionate

damage to urban centres is primarily caused by unchecked development along floodplains, destruction of biodiversity, clearing of natural channels such as mangroves and higher levels of sewage that clog systems. While more storage facilities and dams have been the go to solution for flood control, it needs to be coupled with other methods as well. China's negative list for market access and plans to develop a circular economy to reduce pollutant discharge for certain industries (State Key Laboratory of Urban and Regional Ecology 2018) are plans worth studying, as well as integrating industrial policy planning into overall water management systems. Guangdong Province, a leading export zone in China was the first to publish a negative list in May 2017 and warrants examination for similar high net industrial zones in India[2].

Urban Transformation

It is imperative that India invest in developing basic urban infrastructure related to water and sanitation. This includes everything from modern storm drainage systems, rain water harvesting methods both at the citizen level and larger state level and the protection of natural flood measures amongst others. While some of these are already being advocated by the new water ministry and state governments, it needs to be far wider and deeper, not unlike the *Swachh Bharat* mission campaigns. With temperatures on the rise and India amongst the top 20 countries to be affected by heat, there is greater urgency required. The use of rainwater harvesting and other adaptions to urban infrastructure that could help re-charge groundwater are very relevant to India, which is heavily dependent on fast depleting ground water tables, and aid in times of drought, the frequency of which has increased over time. This ideal could be adopted into India's urban development projects, such as for example the Smart Cities Mission. In its current state the Smart Cities Mission lacks the scale for widespread, integrated adoption of green infrastructure. This is primarily due to the fact that the mission follows a project-based approach: either select areas are developed within cities, or specific "solutions" executed across cities. It also benefits a small percentage of the population: 80 per cent of funds are spent on areas which will help barely 5 per cent of any given city's population (India Today 2019).

China offers some innovative solutions and models that can be easily adapted to the Indian context, including the Sponge Cities project, creation of a monitoring system and the waste water treatment models in Shanghai. While the scale of the sponge cities project cannot be replicated in India, some of the key concepts can be introduced in smaller urban centres. Given the extreme levels of air pollution in several India metros, there is a strong case for environment and water

2 Development and Reform Commission of Guangdong Province released its Negative List of Industrial Access to National Key Ecological Functional Zones in Guangdong Province (Pilot) for eleven counties within the boundaries of key EFZs (Lechang, Nanxiong, Ruyuan, Shixing, Renhua, Longchuan, Heping, Lianping, Jiaoling, Pingyuan and Xingning). These include designated areas of the agriculture sectors (e.g., forestry, animal husbandry and fisheries), manufacturing, wholesale and retail factories, and mining.

ministries to work together where solutions could be cross sectoral. The Shanghai model is a particularly interesting one to note where several World Bank aided projects have helped the city create an impressive waste water treatment connection rate of more than 90 per cent, as well as investing in infrastructure and treatment solutions. The Qingcaosha Raw Water Program was also set up to help the city shift reliance from the over stressed Huangpu River to the Qingcaosha Reservoir, a programme that could prove useful for several Indian cities that are extremely water stressed and have overused their existing resources. Not only does this alleviate water insecurity, it also allows for extremely stressed water bodies to replenish and rejuvenate. Innovative engineering and finance mechanism that was introduced to leverage private funding through the country's first enterprise bond for urban development, similar to the green bond market in Europe aimed at climate related projects, is a useful tool to be considered for the Indian market, that has till date been rather lacklustre on this front (World Bank 2018).

Using technology to map and identify gaps in the system and subsequently plugging in these gaps is another area where greater intervention is required. For example, Miyun District in northeast China that comes under the Beijing municipality built a 300 km fence in 2018 around reservoirs and arranged regular patrols and drones to monitor illegal activity. 'The monitoring system will evolve from the old sporadic monitoring spots to an all-round system with facial recognition covering a distance of 300 km. It will sound alarm immediately against any illegal act and take corresponding measures to ensure water quality.' said Pan Linzhu, a senior official of Miyun District (CGTN 2020). Similar ideas and methods have been implemented to varying degrees in monitoring leakages and illegal dumping of sewage and pollutants in other countries including South Africa, Israel and several European nations and can all be studied for the Indian urban context. The China Mega-City Water Fund, launched through the integration of various stakeholders including financiers, local communities and knowledge partners is hailed as a success story. In this context, the recent India Climate Collaborative that seeks to direct funding and visibility towards climate action in India is another multi-stakeholder initiative that warrants mention.

Demand-Side Management of Water

The current leadership has taken the necessary first steps to elevate the debate around water and sanitation. The Jal Shakti Ministry has formulated several key policies - integrating efforts at the national level by combining water resources, river development, drinking water and sanitation under one umbrella. Water is not just a matter of the resource but is very closely connected to the health, security and economy of a nation. The focus of the ministry is however still very much on the supply side of the issue, and needs to shift to demand side management of water, with focus on effective agricultural practices, sustainable urban use and proper pollution control. The maximum water in India is consumed for irrigation. Here again the Chinese example makes for an interesting study, in terms of having industrial users offset the economic cost of modern irrigation techniques. Going a

step further, we could also bring in greater planning to our cropping choices and patterns. Amarjit Singh, who served for the ministry of water resources, is quoted to have said, “If you look at Maharashtra, 60 per cent of the water is used for growing sugar cane when we are getting sugar much cheaper in the international market than in the domestic market. In the case of rice at least (takes about 3,000 litres to produce a kilogramme of rice), we get about $25 billion as export earnings” (LiveMint 2019). We thus need to consider the close connection between water and economy to drive forward any agenda on water.

For effective demand-side management of water it is also important to consider the river basin as a whole unit and ensure a comprehensive understanding of the entire basin is in place. While the Ganga Rejuvenation project, that has achieved sporadic success at best, is the government’s highlighted project, other rivers also need similar macro level approaches. The Tapi River project under the aegis of the EU-India Water Partnership is a working example and can be studied for other shared rivers within the country. By considering the river basin as a whole unit, these commissions have a better broader understanding of the stress placed on the entire river from source to sea, thus ensuring that solutions are not piecemeal and therefore more sustainable. The Yangtze River Commissions three year action plan that combines protection and exploitation of river is one such intra-state example worth considering, as are other trans-boundary river basin commissions. The new government schemes that have been approved to digitise and update ground water estimates and mapping of aquifers are necessary and should ideally be implemented quickly and in tandem with state governments and other interconnected sectors. With a clearer idea of the state of existing water resources, both underground and surface, and more transparency in this space, future planning could be more ecological and sustainable.

Conclusion

There is no doubt that China has a long way to go to improve its current water stress especially given the vast population, dwindling resources and above all ambitious development agenda. However, the country has arguably made some of the biggest gains in managing their current resources, especially in the area of pollution and regulating supply. Not unlike China, water will be a deciding factor in India’s growth story, and while the new ambitious water welfare scheme that aims to be inclusive, decentralised and community-managed is a step in the right direction it will ultimately be insufficient if implemented in isolation. Water is not just a resource to be utilized for agriculture or consumption, it is closely linked to the health and development of a community and nation and is more often than not subject to vagaries of the climate. Without adequate measures that consider all aspects, water security will be difficult to achieve.

As a developing country we often look to the United Nation’s plans, Europe or other nations that have made greater strides in their water, environment and climate arc, however it is often times also beneficial to look closer home. While China is still in its nascent stage of a more positive water security future, India has

much to learn from both their successes and failures. 2019 saw for the first time a more wide ranging conversation on water security throughout the country, following two years of extreme drought and devastating floods, which brought home the realisation that our water stressed future is now and that solutions can no longer wait for tomorrow. As a country covering numerous climatic zones we deal with everything from over use and waste, simultaneous floods and droughts, scarcity and deluge. Piecemeal solutions will no longer be sufficient and as China and other countries have done it is time we bring in all stakeholders from governments, industry and the end user into the conversation.

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