ISAS Insights
No. 479 – 28 December 2017
Institute of South Asian Studies
National University of Singapore
29 Heng Mui Keng Terrace
#08-06 (Block B)
Singapore 119620
Tel: (65) 6516 4239 Fax: (65) 6776 7505
www.isas.nus.edu.sg
http://southasiandiaspora.org

Ensuring Water Supply in Amaravati: Challenges and Possible Solutions

Amaravati, the new capital city of the Indian State of Andhra Pradesh, faces the challenge of meeting its water-related needs. Although the State government has embarked on several measures in this regards, these are not sufficient to address the city's water-related concerns. This paper examines the severity of the issue and proposes several measures which may help Amaravati to overcome its water-related challenges.

Amit Ranjan[1]

Amaravati is the new capital of the Indian State of Andhra Pradesh. This was the result of Hyderabad, the original capital, becoming the capital of the newly carved-out State, Telangana, in 2014. Amaravati is a planned city built on the banks of River Krishna. According to Andhra Pradesh's Chief Minister, N Chandra Babu Naidu, the capital will become the 'Blue-Green' city. Theoretically, a 'Blue-Green' city introduces the natural water cycle into the urban environment and provides effective measures to manage river, coastal and surface water bodies. According to the Capital Region Development Authority, Amaravati officials have stated that, "Amaravati was planned in such a way that it would have an efficient public transport system, use renewable energy, conserve water, promote green spaces and clean

[1] Dr Amit Ranjan is Visiting Research Fellow at the Institute of South Asian Studies (ISAS), an autonomous research institute at the National University of Singapore (NUS). He can be contacted at isasar@nus.edu.sg. The author bears full responsibility for the facts cited and opinions expressed in this paper.

industries, and minimise carbon footprint".[2] Singapore-based Ascendas-Singbridge and SembCorp Development have been awarded the master development rights for the start-up hub along the waterfront of River Krishna. This area lies within a 20-square kilometre of the SEED Area[3] of Amaravati. The start-up area is to be developed in phases over 15 to 20 years.[4]

Looming Water Scarcity

One of the major challenges Amaravati faces is the insufficient availability of water. It requires about four to ten Trillion Metre Cubic (TMC) feet of water for drinking purpose.[5] According to the data submitted by the State government to the state-level environment impact assessment body, which looks into the impact of infrastructural projects on the environment and is the final authority for clearance, the fully-developed capital will require 1,067 million litres of water per day. Out of this, 203 million litres will be utilised by the industrial sector. To meet the demand, the Andhra Pradesh government has proposed drawing drinking water from River Krishna and its tributary, Kondaveeti Vagu.

Further, it is being assumed that Amaravati will reduce the extent of water bodies by 6.6 square kilometres. "According to official data, water bodies in the proposed capital city are spread over 32.43 square kilometres, including small lakes covering an area of 2.78 square kilometres. But when the capital city becomes operational, the size of the water bodies will come down to 25.78 square kilometres. This includes the reduction in the capacity of River Krishna and its tributary Kondaveeti Vagu."[6] This loss of 6.6 square kilometres may prove detrimental to the local ecological balance.[7]

---

2 "AP capital to be blue and green city", V Raghavendra, *The Hindu*, 5 December 2016. http://www.thehindu.com/news/national/andhra-pradesh/AP-capital-to-be-a-blue-and-green-city/article16763118.ece. Accessed on 14 December 2017.

3 SEED stands for Supporting Entrepreneurs for Environment and Development. It supports the idea of sustainable development and the green economy. Its core values are now followed as a model for development across the world.

4 "Amaravati, a city fast shaping up with dedicated regions", Sreenivas Janyala, *The Indian Express*. http://indianexpress.com/article/business/thematic-cities-amaravati-a-city-fast-shaping-up-with-dedicated-regions-4824569/. Accessed on 15 December 2017.

5 "Water scarcity looms large over Amaravati", P N Srinivasa Rao, *Deccan Chronicle*, 9 May 2016. http://www.deccanchronicle.com/nation/current-affairs/090516/water-scarcity-looms-large-over-amaravati.html . Accessed on 10 December 2017.

6 "Amaravati will shrink water bodies: Experts", Syed Akbar, *The Times of India*, 13 April 2016. https://timesofindia.indiatimes.com/city/hyderabad/Amaravati-will-shrink-water-bodies-Experts/articleshow/51803940.cms. Accessed on 12 December 2017.

7 Ibid.

To address some of Amaravati's water-related challenges, the State government has proposed several supply and demand-side measures. These include the following:

1. A new barrage on River Krishna at Vykuntapuram will connect Amaravati from the Hyderabad-Vijayawada national highway of the Krishna district.[8] There is a prevailing sense that, during heavy rains and floods, water from River Krishna flows unutilised into the Bay of Bengal from the Prakasam Barrage. More than 11 TMC feet of flood water flowed into the sea from the Prakasam Barrage during the rains in 2016. There was then no reservoir between the Nagarjunasagar Dam and the Prakasam Barrage. Now, the Pulichintala project stores 30 TMC feet of water and releases the excess water into River Krishna which then reaches the Prakasam Barrage. This, unfortunately, goes waste, flowing into the sea, due to the absence of an appropriate storage facility. After announcing the establishment of the new capital on the banks of River Krishna, the Andhra Pradesh government now has plans to construct a barrage to store five TMC feet of water.[9] As per the plan, water from River Krishna would be stored at Vykuntapuram Barrage. Further, in the draft master plan developed by the Singaporean companies engaged in developing Amaravati, there is also a suggestion to construct a three-kilometre underwater tunnel between Vijayawada and Amaravati to mainly store extra water.

2. In order to meet the growing demands of water in the State, former irrigation chief engineer, V Satyanarayana, has suggested that the water supply capacity from River Godavari should be increased. The water should be stored by constructing a barrage and the water should be used exclusively for Amaravati's drinking purpose. He added that rain water passing through rivulets from Khamam district to Krishna River could also be stored.[10]

3. Officials from the State irrigation department have requested the government to demand special water quota for Amaravati from the Krishna River Management Board (KRMB) in the next discussion between Andhra Pradesh-Telangana and the KRMB on water-

[8] "New Barrage on Krishna river: Vastu favours Vykuntapuram", Ilyas, M D, *Deccan Chronicle*, 11 October 2016. http://www.deccanchronicle.com/nation/current-affairs/111016/new-barrage-on-krishna-river-vastu-favours-vykuntapuram.html. Accessed on 25 July 2017.

[9] Ibid.

[10] "Water Scarcity looms large over Amaravati", P N Srinivasa, op cit.

sharing issues and projects.[11] The KRMB was set up under the Andhra Pradesh Reorganisation Act, 2014, to regulate the supply of water from River Krishna between the two States (Telangana and Andhra Pradesh), among other functions.[12] After the linking of River Krishna and River Godavari was completed in 2016, it has now become easy to transfer water from one basin to the other to tackle the water-related challenges of the respective basins.

All these aforementioned measures are largely based on the supply-side management of water which mainly focuses on:[13]

1. Finding new sources of water;

2. Increasing storage capacities;

3. Diverting water to increase supply at a particular asset; and

4. Using technology to create clean, potable water from a previously unusable water source.

On the other hand, the demand-side water management focuses on reducing the amount of water for purposes such as household and municipal use, and farming and industrial needs. It mainly focuses on decreasing the burden on water resources by reducing misuse or leakage of water.[14] To address Amaravati's water-related challenges, a combination of both demand- and supply-side of water management is essential.

Apart from ensuring the availability of water, floods also create havoc, especially in cities which do not have an effective water drainage system. In recent years, some Indian cities, such as Mumbai and Chennai, have witnessed disastrous consequences arising from floods due to

---

11 Ibid.

12 Ibid.

13 "Understanding supply-side and demand-side to support water management in the Asia Pacific", Karen Delfau, *KINI-An Initiative for Sharing Water Knowledge*, 9 February 2017. https://kini.waterpartnership.org.au/posts/1338630-understanding-supply-side-and-demand-side-to-support-water-management-in-the-as. Accessed on 15 December 2017.

14 Ibid.

precipitation and inadequate water discharge infrastructure.[15] On the issue of floods discharge capacity, the Amaravati Sustainable Capital City Development Project (ASCCDP), the Andhra Pradesh government document, states that the city is "very less prone to floods as the area is located on the upstream of [the] Prakasam Barrage with well-defined flow regime of Krishna river with strong bunds which have withstood historic flood discharges of around 12 lakh [1.2 million] cusecs."[16] However, the State government is not taking any chances. It is developing flood security plans and taking anti-inundation measures to discharge accumulated water mainly during the rainy season. These plans are prepared by consultants from the Indian Institute of Technology, Madras, and from the Netherlands. The consultants have prepared designs to avoid flood and water stagnation in Guntur and Vijayawada as well. Also, a massive storm water drainage project, funded by the Union Urban Development Ministry, is under construction.[17]

Issue of Water Quality

Like other parts of India, the water quality in Amaravati and the nearby areas is poor. The ground water has been largely polluted by the indiscriminate use of chemical fertilisers and pesticides for decades in horticultural and agricultural crops spread over 30,000 acres near the capital city.[18] In a joint research study carried out by Andhra University, the Indian Institute of Remote Sensing and KL University, it was discovered that the groundwater in the villages that fall under the capital city contain pollution indicators such as the total dissolved solids (TDS), nitrates and fluorides beyond the maximum limit prescribed by the Bureau of Indian Standards.[19] The research also showed that the concentration of alkalinity in these villages

[15] Mumbai and Chennai are two metropolitan coastal cities of India. Almost every year, during the monsoon season, Mumbai gets flooded because of its less than adequate drainage system. During the rains, Mumbai's drainage system becomes clogged at many places. One of the most disastrous floods the city witnessed was in 2005 in which about 1,094 people died. Chennai also experiences flood due to the same reasons as Mumbai. The most recent instances of heavy floods in Chennai were in 2015 and 2017.

[16] Amaravati Sustainable Capital City Development Project (2017), Andhra Pradesh Capital Region Development Authority (APCRDA) Government of Andhra Pradesh, Amaravati, p 22. http://documents.worldbank.org/curated/pt/650051486971245674/pdf/SFG3009-REVISED-EA-P159808-Box405298B-PUBLIC-Disclosed-8-30-2017.pdf. Accessed on 15 December 2017.

[17] "Amaravati, a city fast shaping up with dedicated regions", Sreenivas Janyala, op cit.

[18] "Amaravati groundwater highly polluted: Report", Syed Akbar, *Times News Network*, 2 November 2015. https://timesofindia.indiatimes.com/city/hyderabad/Amaravati-grondwater-highly-polluted-Report/articleshow/49623587.cms. Accessed on 10 December 2017.

[19] Ibid.

ranged between 200 milligram per litre and 400 milligram per litre.[20] Most of the alkalinity is because of the concentration of calcium carbonate in the water. According to the United States Environmental Protection Agency (USEPA), a concentration of more than two milligram of calcium carbonate in a litre of water is not acceptable.[21]

On the water quality in Amaravati, the findings of the ASCCDP, after evaluating the baseline ground water quality at 35 locations and analysing the samples as per International Standard (IS)2296 specifications and IS10500, concluded that:[22]

1. The maximum value of chlorides (1,300 milligram per litre) at Ainavolu was found to exceed the acceptable limit as per IS10500 for drinking water (250 milligram per litre). The chloride content at a few other locations, such as Nowluru and Ananthavaram, also exceeded the permissible limits.

2. The maximum value of fluorides (1.1 milligram per litre) was found to exceed the acceptable limit for the same as per IS10500 for drinking water (1.0 milligram per litre).

3. The maximum value of cadmium (0.003 milligram per litre) at Ainavolu was found to exceed the acceptable limit for the same as per IS10500 for drinking water (0.001 milligram per litre). The cadmium levels at all other locations were below the permissible limit.

4. The maximum value of TDS (6,658 milligram per litre) at Ainavolu was found to exceed the acceptable limit for the same as per IS10500 for drinking environmental and social management framework water (500 milligram per litre). The TDS value also exceeds the permissible limits at many locations in the study area.

5. The maximum value of sulphates (520 milligram per litre) at Ainavolu was found to exceed the acceptable limit for the same as per IS10500 for drinking water (200

[20] Ibid.
[21] 'What is Alkalinity?' http://www.freedrinkingwater.com/water_quality/quality1/28-08-alkalinity.htm. Accessed on 21 December 2017.
[22] Amaravati Sustainable Capital City Development Project (2017), op cit, p 30-31.

milligram per litre). The sulphate value also exceeds the permissible limits at many locations in the study area.

Amaravati's surface water samples, as stated in the document, show:[23]

1. The value of TDS is very high at Thulluru Lake (3,031 milligram per litre) near Mandadam (1,464 milligram per litre). The TDS was found to exceed the acceptable limit for the same as per IS10500 for drinking water (500 milligram per litre) at many locations within the study area.

2. The maximum value of chlorides (578 milligram per litre) at a lake near Mandadam was found at to exceed the acceptable limit for the same as per IS10500 for drinking water (250 milligram per litre). However, the values of chlorides are within permissible limits in all other locations.

3. The maximum value of sulphates (296 milligram per litre) was found to exceed the acceptable limit for the same as per IS10500 for drinking water (200 milligram per litre) at one location in a lake near Mandadam.

4. The maximum value of nitrates (86 milligram per litre) was found to exceed the acceptable limit for the same as per IS10500 for drinking water (45 milligram per litre) at one location in a lake near Mandadam.

5. The values of dissolved oxygen varied from 3.2 milligram per litre (500 metres left of Prakasam Barrage) to 5.6 milligram per litre (in a pond in Thulluru). The values of dissolved oxygen are considerably low at many locations, showing biological and chemical contamination of the surface water bodies.

Amaravati has scarce water resources and most of those available are, unfortunately, polluted. The biggest challenge, therefore, for the city developers is to address the two challenges simultaneously.

[23] Ibid.

Possible Solutions

The following are some suggestions to address the water-related challenges in Amaravati:

1. As a first step, there is a need to clean up the polluted rivers and other water bodies in the State. If the State government does not have the required technology, it could engage private companies to undertake the necessary cleaning of the rivers and water bodies. For example, since 2012, an Israeli company, Aqwise, through a local implementation partner, has been purifying and supply drinking water form River Yamuna to the residents of Agra in Uttar Pradesh. It uses the Moving Bed Biological Reactor technology to clean 150,000 cubic metres of water daily for over two million residents and visitors in Agra. This technology is simple, inexpensive and transferable to other parts of the country.[24]

2. The National Water Policy (NWP) of India, 2012, supports the idea of water pricing. It states that, the "pricing of water should ensure its efficient use and [it should] reward conservation. An equitable access to water for all and its fair pricing, for drinking and other uses such as sanitation, agricultural and industrial purposes, should be arrived at through the independent statutory Water Regulatory Authority, set up by each State, after wide-ranging consultation with all stakeholders".[25] In most of the urban areas of India, consumers are charged for water usage. This pricing in some parts of the country has created water inequality – the poor receive less or almost no water while the rich pay and get the amount of water they want. The 2006 Human Development Report on Water had expressed this concern. Therefore, while charging consumers for water usage, there is a need to maintain a fair balance in the supply of water between the rich and the poor.

3. The NWP of India, 2012, also stated that "the over-drawal of groundwater should be minimised by regulating the use of electricity for its extraction".[26] In some localities in

[24] See Saleem, Faiza (2017) India and Israel: Cooperation on Water Management, *ISAS Insights* No. 442, 27 July 2017. https://www.isas.nus.edu.sg/ISAS%20Reports/ISAS%20Insights%20No.%20442-%20India%20and%20Israel-Cooperation%20in%20Water%20Management.pdf Accessed on 14 December 2017.

[25] National Water Policy, 2012, Ministry of Water Resources, Government of India. http://wrmin.nic.in/writereaddata/NationalWaterPolicy/NWP2012Eng6495132651.pdf. Accessed on 14 December 2017.

[26] Ibid.

Indian cities, separate water meters have been installed to monitor the extraction of ground water by individuals or industrial units. This method could be implemented on a large scale in Amaravati to monitor and manage ground water extraction. The ASCCDP document mentions fixing water reading meters to address the issue of ground water drawl. However, the extent to which this is being done has to be closely monitored.

4. If Amaravati is able to reclaim water, it would be a major achievement for the capital. The ASCCDP maintains that its aim is to "reduce, re-cycle and reuse" water.[27] The document also promises that "safe drinking water will be supplied to every household with a well-established network after its treatment to meet the IS10500 standards; sewage will be treated and recycled for landscaping purposes."[28] It is estimated that, once developed, the city will generate about 877 million litres of waste water. Out of that, the industries will contribute about 175 million litres.[29] If the water can be treated and re-used, it could provide some relief to the current water constraint in Amaravati.

In Singapore, used water is collected through a network of sewers that lead to water reclamation plants. Through this process, each year, about 595 million cubic metres of used water is treated to international standards stipulated by the USEPA and World Health Organization.[30] To carry out water treatment, Singapore's national water agency has given water filtration projects to a private company, Hyflux. The company uses "ultrafiltration and reverse osmosis processes as well as ultraviolet disinfection to treat secondary effluent, making it ultra-clean and safe to drink. NEWater is mainly used for industrial and air-condition cooling purposes. This high-grade reclaimed water provides the country with a sustainable and drought-proof source of water".[31]

5. The rainwater harvesting technique could also be used in Amaravati. This has been successfully used in many countries, including Singapore. This method allows rain water to be collected in tanks and then harvested for use for various purposes.

---

[27] Amaravati Sustainable Capital City Development Project (2017), Andhra Pradesh Capital Region Development Authority (APCRDA), op cit.

[28] Ibid, p 38.

[29] "Amaravati will shrink water bodies: Experts", Syed Akbar, op cit.

[30] "'Used Water' PUB, Singapore's National Water Agency". https://www.pub.gov.sg/usedwater. Accessed on 14 December 2017.

[31] Hyflux Retrieved from https://www.hyflux.com/highlights/bedok-newater-plant/. Accessed on 21 December 2017.

6. The desalination of sea water by fixing desalination plant in the nearby sea could also help meet some of the water-related needs of Amaravati. In Chennai, the Metropolitan Water Supply and Sewerage Board in a collaboration with VA Tech Wabag, and an Israeli company, IDE Technologies, have set up a water desalination plant with a capacity of 100,000 cubic metres. This plant converts sea water into potable water for over one million people who reside in the suburbs of Chennai.[32] As the nearest shoreline to Amaravati is the Bay of Bengal which is about 80 kilometres from the city, desalinated water could be transferred to the city through a pipeline. Australia has been transporting desalinated water for years. In certain parts of China, inter-river water is mainly transferred from one region to another through pipelines, though this water transfer project has created more problems than offering solutions to the country's water woes. For instance, the South to North Water Diversion project has led to the displacement of about 400,000 people and it has also polluted those rivers which were earlier free from pollution. Therefore, learning from the China experience and after taking the necessary steps to address any such issues, pipelines can be set up to transfer desalinated water from the sea to Amaravati.

Conclusion

As the supply of adequate water will be important for Amaravati's lifeline, it is pertinent for the State to develop a comprehensive water infrastructure in the city and around it. Instead of depending on currently available water, the State government must initiate relevant measures to ensure the continuous availability of water and its efficient use for consumption and industrial use. It can learn from small countries such as Singapore and Israel which have been able to effectively manage their water resources through a variety of measures, including the use of modern technology. As Ascendas-Singbridge and SembCorp Development are the master planners of the start-up hub at River Krishna's front in Amaravati, they may be able to offer the necessary expertise to establish a Singapore-style water management infrastructure not only in the capital city but also in the adjoining areas.

. . . . .

[32] Saleem, Faiza (2017) India and Israel: Cooperation on Water Management, op cit.