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Relevance of Traditional Water conservation Techniques in Urban Scenario

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Abstract

There is a well-established trend of migration of rural population to urban areas. The migration takes place due to economic reasons. Cities have witnessed many folds physical expansion to accommodate exodus of population. The civic infrastructure like water supply, sewage system etc are under extreme stress. No big cities are in a position to sustain its water supply with in its own means. This sought for an immediate requirement of conservation of water sources and revival of the existing water conservation facilities, build over a period of time but now in a state of disuse. Revival of traditional water conservation structures / techniques can substantially reduce dependency of metros on external water sources to meet its daily requirement.

Keywords: *Migration of population; Inadequacy of water in big cities; Water conservation techniques; Efforts at micro level*

Introduction

Over last couple of decades, world has seen an exodus of population from rural areas to urban population centres. The phenomenon is more prevalent in developing countries. India has no exception of this large-scale exodus. 'In India, the number of people living in urban areas is expected to more than double and grow to around 800 million by 2050'.

TABLE 1. **Urbanisation pattern india.**

Year	Population							
	5 million & above		1- 5 million		1 lakh - 1 million		< 1 lakh	
	Cities	Urban %	Cities	Urban %	Cities	Urban %	Towns	Urban %
1911	0	0	2	9	22	18.7	1768	72.3
1921	0	0	2	11.4	28	18.6	1887	70

1931	0	0	2	10.4	34	21.1	2004	68.6
1941	0	0	2	12.2	49	26.4	2087	61.3
1951	0	0	5	18.9	72	26.2	2720	55
1961	1	7.7	6	15.9	100	28.3	2223	48.1
1971	2	13	7	13.3	143	30.9	2405	42.9
1981	3	15.6	9	12.1	207	33.5	3027	38.9
1991	4	17.4	19	15.6	276	31.4	3401	35.7
2001	6	21.1	29	16.7	359	30.8	3984	31.4
2011	8	22.5	45	20.1	415	27.6	5698	29.7

The table shows a pattern of shift of population from rural areas / small towns to urban areas / large towns. Large scale migration poses unprecedented challenges for water management in urban India. The primary reason for migration of rural population is attributed to, population growth resulting in division of land holdings in rural areas. Fragmented land holdings as a result of distribution in the family tree over generations, virtually rendering it unsustainable. 'Over 80 per cent of rural households have marginal landholdings of less than one hectare and just seven per cent own more than two hectares. Across the country, in every State, landholdings have decreased in size, almost halving in the last 20 years; in 1992, the average rural household was a small landholder with over one hectare of land, as compared with a marginal land-holder as of 2013 with 0.59 hectares of land'. The migration of rural population to urban areas is also attributed to more lucrative job avenues and better facilities like education, medical care etc. A shift from aggregation economy to production and service sector-based economy has defiantly put the Indian economy on a rising curve but has put the immense pressure on the limited urban resources be it basic amenities like sanitation facilities, access to portable water, electricity etc. Mass scale migration has also resulted in substantial increase in clusters of slums in cities. Even the new multi-level, high raised housing and commercial projects, haphazardly planned in and around the cities done more damage than providing facilities. Rapid, unplanned urbanisation has chocked the cities [1]. The low laying areas, traditional Talabs / Pokhara / Wells / Bawdies, small forests in vicinity of the cities have now been taken over by glossy high raised concrete structures or slums. All major cities are witnessing sharp fall in ground water table due to rampart extraction, the rivers adjoining the cities have now been converted in to stinking GANDA NALA. Leave apart drinking water, no sane person can even think of taking a holy dip in the river. Even the aquatic life has shrunk to the margin, barely surviving.

Methods

Water Supply in Urban Scenario

Rural Water Management Initiative

The concept of water supply in urban areas is different from rural areas. Rural areas have dependency on the traditional, environmentally friendly means. Concept of Talab / Well / Bawdi, the traditional means of water supply is still alive. Villagers have taken a call from the water problem being faced in urban areas. The process of reviving traditional water sources has already started in many rural parts of India [2]. Bundelkhand region, covering thirteen contiguous districts of Uttar Pradesh and Madhya Pradesh, has a long history of water scarcity and draughts has taken initiative. It covers six

districts from Uttar Pradesh (namely, Banda, Chitrakoot, Hamirpur, Jhansi, Lalitpur and Mahoba) and seven districts of Madhya Pradesh (Chhatarpur, Damoh, Datia, Niwari, Panna, Sagar and Tikamgarh).

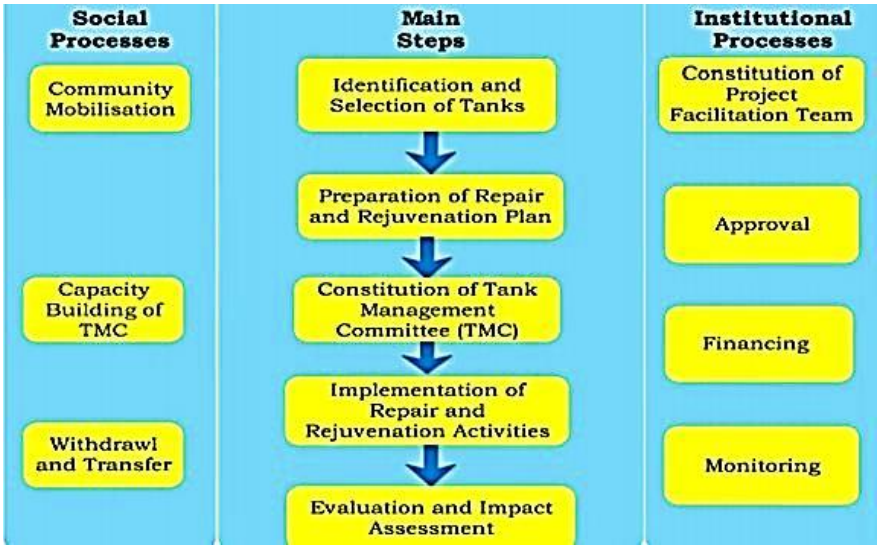

FIG.1. **Model adopted by Bundelkhand administration.**

Bundelkhand Administration adopted the model of community mobilization by providing them technical and financial support [3]. Repair and rejuvenation of the traditional water bodies comprises of four main stages, namely identification and selection, planning, implementation, and post revival management. The tradition 'Talabs' were revived by desilting and removing encroachments. Water feeding channels to the talabs were revived. As a result of small local initiative, many villages of Bundelkhand, otherwise a water deficit region now have adequate water not only for drinking and livestock but can also sustain crop irrigation to some extent [4].

Urban Scenario-Water Supply and sources

The urban water supply scenario is totally different from rural approach. As per Ministry of Housing and Urban Affairs, 135 litres per capita per day (lpcd) has been suggested as the benchmark for urban water supply. For rural areas, a minimum service delivery of 55 lpcd has been fixed under Jal Jeevan Mission, which may be enhanced to higher level by states [5]. The data at the prim facia indicates, more than double per capita water consumption in urban areas. The larger the city, more is the water requirement and more are the expectations of end user. Irrespective of availability of water source, each house hold in the urban environment expects 24 hours running tap water [6]. Majority of urban centres like NCR (Including Delhi, Gurugram, Noida and Ghaziabad), Bangalore, Hyderabad etc have seen upscale population growth in last decades. None of these cities are self sufficient to meet their water requirement. The meagre availability of water from sources within, is grossly inadequate. Majority of the demand is meet through external sources. As per 'Composite Water Management Index NITI Aayog August 2019' report 'India is suffering from the worst water crisis in its history and millions of lives and livelihoods are under threat [7]. Currently, 600 million Indians face high to extreme water stress and about two lakh people die every year due to inadequate access to safe water. The crisis is only going to get worse. By 2030, the country's water demand is projected to be twice the available supply, as per the report of National Commission for Integrated Water Resource Development of MoWR, the water requirement by 2050 in high use scenario is likely to be a milder 1,180 BCM, whereas the present-day availability is 695 BCM. The total availability of water possible in country is still lower than this projected demand, at 1,137 BCM.' This report indicates sharp decline in ground water level across 21 major cities in India Including

Delhi and Bangalore [8]. Delhi's daily water requirement is determined taking into account the needs of the city's permanent and floating populations, and is calculated based on people's consumption of water for various purposes. According to the Delhi Jal Board (DJB), the city's water production and supply agency, Delhi requires 172 litres per capita daily (lpcd) of water for meeting the needs of its domestic consumers (i.e., households), and another 102 lpcd for non-domestic consumers, such as industries, commercial establishments, hotels, and fire stations. Thus, the city needs a total of 274 lpcd of water every day [9]. This quantity of 274 lpcd is fixed in accordance with the water supply norms developed by the Central Public Health and Environmental Engineering Organisation (CPHEEO) for metropolitan and mega cities. Based on a per capita daily consumer requirement of 274 lpcd, Delhi's estimated total daily water demand in 2019, for a population of about 21 million, was 1,260 million gallons per day (mgpd). It is projected that the demand will further increase to 1,380 mgpd by end of 2021, for a population size of 23 million.

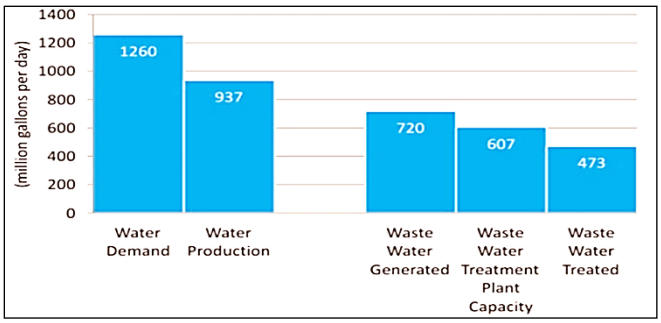

FIG.2. **Gaps in water production waste water treatment, 2019.**

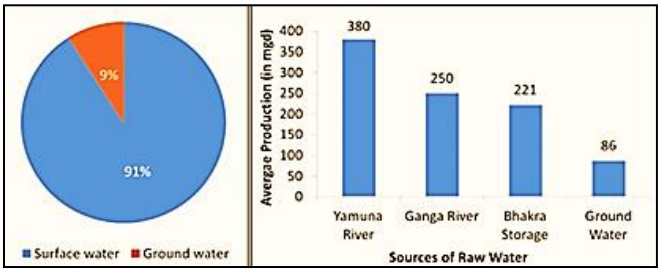

FIG.3. **Sources of Raw Water, 2019.**

As can be seen from above data, Delhi has a water deficit of 25.63% with production capacity at 937 million gallons per day (mgpd) against demand of 1260 mgpd. Out of availability of 937 mgpd, only 380 mgpd (40% of available water and 30% of required) is available from Yamuna. 86 mgpd (9.2% of available water and 6.8% of required) is ground water [10]. Situation of cities like Bangalore, Chennai, Pune is no different. More or less the statistics is the same across all major cities in the country.

Results

Reasons Attributed for Water Crisis

The ever-increasing water demand and increasing dependency on external water sources in majority of big cities including Delhi is be attributed to various factors. First and foremost is population growth coupled with industrial growth. In last 20 years Delhi and Bangalore have seen 125 % and 95% increase in population respectively [11]. The expansion of cities included industrial development, development of associated services like improved connectivity (metro, flyovers, road network, expansion of air ports etc) and planned and unplanned residential complexes.

FIG.4. **Expansion of IGI airport 2000 to 2020.**

Fig.2 shows expansion of IGI airport New Delhi. Land adjoining airport in 2000 was a low-lying area with its share of water bodies. By 2020 the land scape was converted in a landing strip as part of the extension of IGI airport. The urbanisation took place at the cost of environment [12]. Forest land at the outskirts of the towns, over a period of time converted in to concrete jungle. Low lying areas, a natural soak point during rainy season, were indiscriminately levelled. The green landscapes adjoining the city boundaries, full of life and flourishing with flora and fauna, engulfed by expending urbanisation and covered with concrete jungle. Natural water ways acting as drains to the city also encroached, levelled and chocked resulting in flooding of cities in rainy season. The precious rain water instead of being soaked by ground goes down the drain. Flow of untreated sewage, industrial waste in to the water bodies has polluted the surface water bodies and aquafers. Pollution level has already crossed the extreme limits and still unchecked and increasing at a rapid rate. Disposal of municipal solid waste in to landfills in another cause for the contamination of water. Due to unplanned disposal, landfills are more than 100% over loaded. Huge piles of garbage can be seen form distance at the entrance of any major city [13]. No or minimal efforts are being taken for the disposal of garbage, accumulated over years in landfills. Rainy season brings havocs, the large piles of garbage get saturated with water and start bleeding with leach. It not only produces unbearable foul odour, but also percolates down to the ground water and contaminates the acqufires. The water problem in the cities can be simply defined as, surface water sources are badly polluted and are grossly inadequate to meet the water supply requirements. Due to extensive extraction, ground water table is going down at an alarming rate [14].

Discussion

Relevance of Traditional Water Conservation Techniques in Urban Scenario

Arithmetically, India is still water surplus and receives enough annual rainfall to meet the need of over one billion plus people. According to the Central Water Commission, India needs a maximum of 3,000 billion cubic metres of water a year while it receives 4,000 billion cubic metres of rain. Due to lack of infrastructure and awareness, India captures only 8% of its annual rainfall - among the lowest in the world. The traditional modes of water capturing in ponds / Talabs / Baolis have been lost to rampart urbanisation and lack of planning and foresight of civic authorities. India has been also poor in treatment and re-use of household wastewater. About 80 % of the water reaching households in India are drained out as waste flow through sewage to pollute other water bodies. Lack of town planning and foresight has lost majority of natural water storage features and traditional water conservation structures.

Ncr a Fast-Growing Region

Take an example of National Capital Region comprising of Delhi at the centre, surrounded by Gurugram, Noida, Ghaziabad and Faridabad. Last twenty years have seen exponential population growth and expansion of NCR in terms of area. The population growth of NCR also resulted in commensurate physical expansion and increased demand of water and sanitation facilities. Gurugram is expected to see a 240% plus population growth by end of 2021. This population growth is mostly due to migrant population.

TABLE 2. **Population growth in ncr.**

S.no	City	Population in 2001in lakhs	Expected Population in 2021inn lakhs	% Growth
1	Delhi	138.45	311.80	125.21%
2	Noida	12.02	18.59	54.66%
3	Gurugram	8.70	30.00	244.83%
4	Ghaziabad # (2011)	# 17.30	23.75	37.28%
5	Faridabad	13.65	23.40	71.43%

Gurugram 'The Millennium City'

Whatever could go wrong has gone wrong in the urban planning of the Millennium City 'Gurugram'. About two decades back, Gurugram was a small sleepy town in the outskirts of Delhi in Aravalli region. The Gurugram landscape was dotted with farm lands, typical forests of Aravalli region, low laying areas and natural water bodies. The region had its own flora and fauna with its own small eco system. Haphazard expansion of Gurugram, led by builders, severely damaged the natural ecosystem of the region. Natural low laying areas used to collect rain water runoff, serving as small water reservoirs and also as ground water recharge points, were grabbed by the builders. Large areas were converted in to magnanimous, impressive commercial complexes or luxurious residential complexes. Swath of Aravalli forest were destroyed and converted in to concrete jungles. The flour and fauns were lost forever. The green cover and forest land used to act as natural water soaking grounds were lost. As a result, in less than five years, water table of Gurugram has gone down by more than four meters. Prior to so called rapid development of the Millennium City, landscape of Gurugram was scattered with traditional water conservation / harvesting structures like Talabs, Baolis, small earthen check dams, natural water flow channels leading to low laying areas. Prior to inception of Millennium City, all such natural water retaining structures used to get filled to the brim during rainy season. These water retaining bodies firstly acted as recharge points for ground water and secondly as surface water bodies where water was available in non-rainy season. Post conversion of Gurugram in to the millennium city, all such natural water bodies were deep buried under the concrete jungle. Rainy water which used to fill the water retaining structures, instead started flooding the city. During monsoons, flooding problem gets so aggravated, that on many occasions city traffic comes to a standstill. Most of the localities gets water logged. Sewage system gets blocked and basements of multistorey buildings gets flooded with sewer water. Story does not end here, Gurugram also faces severe drinking water shortage in monsoons due to flooding of water treatment and supply installations.

Problem in other areas

The Gurugram model can be simply compared with any fast-growing city in India be it Hyderabad, Bangalore or Noida. The primary reason for emerging water stress is, unplanned and haphazard development. The civic authorities left, development part totally on the commercial developers. Commercial developers or builders did make the necessary infrastructure to support growing commercial need, be it office space, malls or shopping complexes, residential accommodation or road/metro

connectivity but at the cost of badly damaging the local eco system. Civic authorities, at most of the places failed to strike a balance between development and protection of water resources & eco system.

Traditional Water Conservation Techniques

It is indeed astonishing to realize that, at the dawn of civilization, the humans understood the significance and importance of water. Apart from domestic uses, water is vital for cultivation and irrigation of crops. According to Rig Veda all life on earth is evolved from water. Due to significance of water in all sphere of life, water has been termed as Varun Dev and god of rain as Indre Dev. The Rigveda, Yajurveda, and Atharvaveda, have many references to the water cycle and associated processes, including water quality, hydraulic machines, hydro-structures, and nature-based solutions (NBS) for water management. The Rigveda mentions that "the God has created Sun and placed it in such a position that it illuminates the whole universe and extracts water continuously (in the form of vapor) and then converts it to cloud and ultimately discharges as rain" (verse I, 7.3). Many other verses of the Rigveda (I, 19.7; I, 23.17; I, 32.9) further explain the transfer of water from the Earth to the atmosphere by the Sun and wind; breaking up of water into small particles, evaporation due to Sun rays, and subsequent rain; and formation of cloud due to evaporation of water from Mother Earth and returning in the form of rain. Verse I, 32.10, of the Rigveda further mentions that the water is never stationary but it continuously gets evaporated. According to Atharvaveda also (~ 1200–1000 BCE), the Sun rays are the main cause of rain and evaporation (verse I, 5.2, in Sanskrit language). Right from the very beginning of evolution of human being on earth, all major civilizations established in the vicinity of major water sources. Mesopotamia is one of the oldest civilizations in a region of southwest Asia in the Tigris and Euphrates river system. Egyptian civilization, builders of the great pyramids, developed alongside rive Nile.

Dholavira, an important city in the Indus Valley civilization, contained sophisticated water management systems comprising series of reservoirs, step wells, and channels. The city was ringed with a series of 16 large reservoirs (7 m deep and 79 m long), with some of them interconnected together; these storage structures account for about 10 % of the area of the city. There is evidence that the Harappans constructed low-cost water-harvesting structures such as small check dams and bunds using rock-cut pieces and boulders [2]. The Dholavira city was located between the ephemeral nullahs (streams) Mansar in the north and Manhar in the south and was equipped with a series of small check dams, stone drains for diverting water, and bunds to reduce the water velocity and thus to reduce siltation in the main reservoirs. The Yajurveda also has references directing the man to use rain and river water by means of wells, ponds, and dams and to distribute it to various places having need of water for agriculture and other purposes. The Atharvaveda talks about drought management through efficient use of available water resources and emphasizes that these waters are used efficiently and will reduce the intensity of droughts. During the Sangam Period (300 BCE to 300 AD), in the southern parts of India, rainwater-harvesting structures such as tanks were constructed for irrigating the paddy fields, and fishing was also practiced in these ponds [14]. The Grand Anicut (Build on Cauvery river Tiruchirapalli in Thanjavur district of Tamilnadu) was constructed by the Chola King Karikalan during the first century AD on the river Cauvery for protection of the downstream populations against flood and to provide for irrigation supplies in the Cauvery delta region. The Grand Anicut is the world's oldest, still in use dam and is also credited with being the fourth oldest dam in the world and the first in India

Uses of Traditional Water Conservations Techniques in Major Cities And Challenges

All big cities of old time have now been termed as Metros. Old cities had tradition water storage and conservation techniques. Population growth and expansion of cities in the process of conversion in to Metros, has adversely affected city's' water dynamics. Old cities were more or less self sufficient to meet their water needs. It was essential as the facility/technology of

suppling water from far flung areas was not available at that time as being done in the current scenario. How to destress the existing water supply system in big cities, to ensure availability of water to the population? Apart from taking various measures such as rain water harvesting, conservation of water, recycling of ware etc, there is a need to identify the old, defunct water storage / conservation facilities already existing and are lying in a state of disuse. Delhi being the historic city and also facing acute water shortage, has lots of potential for revival of old water retaining structures. Being a historic city, rules of different eras made their contribution for development of water retaining structures in and around Delhi. Among all the water retaining structures, Baolis were the most prevailing rain water storage structures. There are more than 100 Baolis in Delhi.

Revival of old Baolis

A Baoli is a typical type of step well. Baoli is typically rain water fed water retaining structure. Baolis were so sited to take advantage of the grain of the ground so that the surface runoff in rainy season finds its way in to the Baoli. In a way, a Baoli has its own catchment area. Revival of baolis in Delhi is a herculean task. Most of the Baolis are lost in the concrete jungle. Their catchment areas have been encroached. The first step towards revival of Baolis is identification of such structures.

Identification and Revival of Old Talab/Pokhar/Johad

Talab/ Pokhar/Tal/ Johad/ Lake are different names for similar type of water retaining structures. The name changes as per size and location of the water retaining bodies. Talab / Pokhar are comparatively small in size and could be natural or manmade. Name Tal and Johad are more prevalent in western India [3]. Rajasthan, being a rain deficit state is full of Tals. These water retaining bodies are naturally located in low laying areas having their own small catchment area. Lake also falls in the same category but size and extend of the lake is much larger as compared to a talab, pokhar or johad. Lakes are natural bodies or may be manmade, having larger catchment areas. Many rivers also originate from lakes. Use of such water retaining bodies for drinking and irrigation purpose is still prevalent in rural India. During rainy season these structures serve as storage point of rain water runoff. Water from the catchment areas flows in to these water retaining bodies. Stored water is used in dry season. Depending on the size and storage capacity of the water body, stored water can be used for human consumption, sustenance of livestock and may for irrigation purpose [5]. These water bodies also act as recharging points for ground water. Small water bodies like Talab/ Pokhar/Tal/ Johad still have lots of significance in rural India. Even the big cities also had such function water storage bodies and were more or less self-contended in good olden days. However due to rampart urbanisation, most of the cities have lost their natural surface water bodies. Historically, cities were built along waterways or lakes. The multi-faceted relationship between urban planning and water has influenced the development of metropolitan areas, cities, towns and even neighbourhoods throughout history and will continue to do so [6].

Conclusion

Industrialization and urbanization are the need of the hour. A fast-developing country like India has a progressive economy. The cities will grow, more and more people will migrate from rural areas and settle in urban areas. City resources will be stretched to maximum limits and at times fails to meet growing requirements. Ever growing demand of water stress needs to be addressed. Water can not be produced but it can be conserved. Revival of traditional water conservation techniques and restoration of old existing water storage structures in urban scenario in the need of the hour. Earlier it is done the better it is.

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Conflict of Interest

None

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