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Research Paper

Urbanization & Urban water Supply Management – Case Study of Agra City

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ABSTRACT: *Yamuna, one of the major rivers of North India is on a verge of drying and has a depleting water quality and quantity. There is a continous growth in the demand of water with urbanization, industrialization build up space, but our municipal corporation is not able to meet the demand. Thus the public uses underground water to fulfill its needs. This is also reducing the ground water level. The actual level of ground water should be 8-10 meters, but the ground water level of the city has dropped to 36 -44 meters. Out of 15 blocks 12 blocks have been declared to have dry aquifer condition. Growing demand is next to growing extraction to a condition that the river has meagre water in it. The city has failed to develop an alternative water source apart from haulage from Yamuna .All parameters revealing water quality and quantity are on papers with least reference of common man. We need government and common man's concern to save water for future.*
Keywords: *Yamuna River, Municipal Corporation, Permeable Aquifers.*

I INTRODUCTION

Yamuna originates from the Yamunotri Glacier of Uttar Kashi in Uttar Pradesh. Its total length is around 1370 kilometers. Yamuna flows through the states of Delhi, Haryana and Uttar Pradesh, before merging with the Ganges at Allahabad. Recent facts and findings of the river points add to the fact that the river is in trouble: the river is overtaxed, channelized, heavily polluted and slowly dying. It is without continuous flow for nine months of the year (CPCB 2006). Its dire condition has been the spectacle of costly government clean-up efforts (Mahapatra, 2012), media attention and public outrage, but the state of the river remains dark. Moreover, the collective memory of the river in a better state is fading, as the majority of the region's population, particularly in New Delhi, was born after barrage construction restricted river flow (Singh, 2012)On the basis of hydrological and ecological conditions Yamuna has been classified into five segments that are Himalayan Segment, Upper Segment, Delhi Segment, Eutriphicated Segment and Diluted.

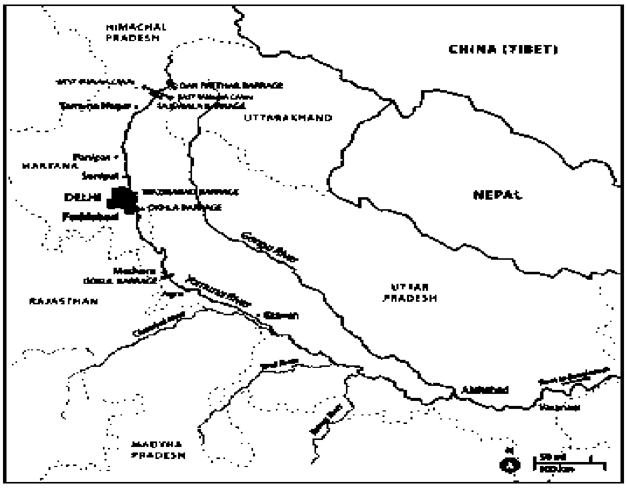

Figure 1: Yamuna River and its barrages

Study area:

The present study is based on the urban water supply management of the city of Agra. The average area of the city is 188.40 km^2. The population of the city is around 1,746,467 (2011). It has a semi arid climate. The soil is generally loose and sandy. The city has been divided into 90 blocks.

Objectives:

The present study tries to find out the:

1. Growth in demand of water in between two census years and whether there has been any change in the source and management of urban water supply in between two census years
2. Effect on non-renewable resources as a result of the city's water management technique
3. Conservatory methods which can be adopted for sustainable development of water resources in the city

II. Discussion

1. Growth in demand of water in between two census years

The city is divided into 15 blocks. The total population of the city according to 2001 census was— 1,234,234 which has increased to 1,746,467 in 2011. There is no increase in the total number of the blocks of the city. According to the United Nations the per capita water requirement stand at 50 liters/person/day inclusive of all requirements. This means in 2001 the water requirement for the city was 61,711,700 and in 2011 this has increased to 87,323.350 cubic meters. Along with this the enormous amount of water required for the various industries, more prominent being Petha and leather industries requiring huge amount of water. However from the present statistics of water distribution it is clear that the increased capacity has not been met. There has been rapid urbanization and urban sprawl in the fringe areas of the city during this span of ten years. Further the density of population has also risen unprecedentedly from 6,330/km square in 2001 to 8,954/km square in 2011. Total haulage from Yamuna annually in its entire flow is 4,400 cubic meters (www.rainwaterharvesting.org/crisis/river-yamuna.htm). Thus there is a huge demand- supply gap in supply of water.

The total mean annual flow for the Yamuna river up to the Delhi stretch is about 13.9 thousand million cubic meter (TMCM) (Jha, 1988). The water abstraction from river Yamuna for irrigation and drinking water uses till Delhi is about 9.5 TMCM (CPCB, 2006). This leaves only a free river flow of about 4.4 TMCM. For the Yamuna, 80% of the flow (11 TMCM) occurs in the monsoon months (July to September) and 20% (2.8 TMCM) in the nine non-monsoon months (Janunary to June and October to December) (Jha, 1988, CPCB, 2006).

For nearly nine months of the year, there is no continuous flow in the Yamuna, due to the near complete diversion for human consumption at barrages along the river. During the lean season the river is left with a water depth of only 1 ft.

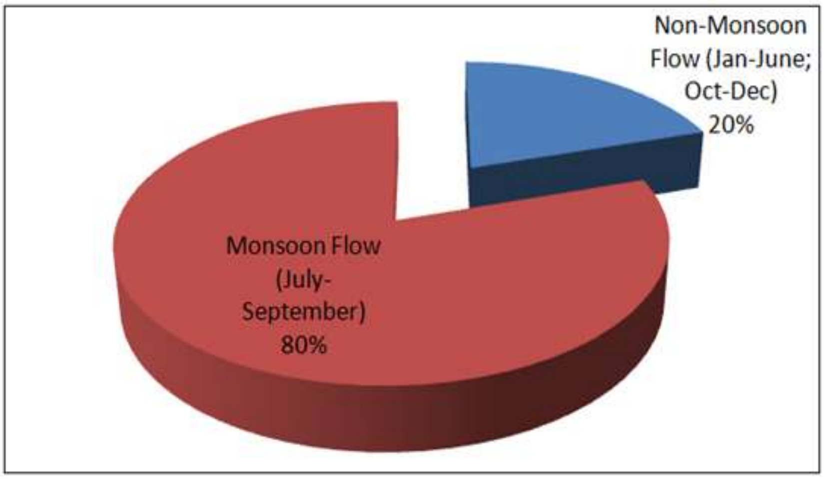

Figure 2: Water Flow Estimation in Yamuna River

There are two sources for the city's supply of water. The primary source is public source, met by the municipal corporation and the second is private source wherein submersibles are dug in the permeable aquifers at an average depth of 40mts. However this water is alkaline owing to shallow aquifer depth and underlying rocks and has heavy iron content which is completely unsuitable for direct consumption. The corporation water supply depends on haulage from Yamuna. There are different zonal pumping stations (ZPS) in every block of the city with 3 ZPS offices Surya Nagar,Lohamandi,Tajganj. However the river water is so much polluted with heavy metals (lead, Zinc, nickel, cadmium etc) and toxic elements apart from organic wastes that no amount of purification can rectify it. The average BOD value ranges from 14 -28 mg/l along with high coliform content (Malik et al. (2014). The city thus has to depend completely on bottled drinking water for direct consumption. People who cannot afford it depend on the supply water notwithstanding the health hazards. Areas with higher consumption requirement opt for submersibles wherein the already depleting ground water is hauled. During summer season the flow of water gets restricted (due to fall in the river water volume) to the extent of non availability of water for 4-5 days at a stretch in certain parts of the city. During these times the city has no other option but to use bottled water for washing and sanitation. Thus it can be said that within a span of 10 years the city has been unable to develop any other source of water for its population.

Effect On Non-Renewable Resources As A Result Of The City's Water Management Technique

Ideally, heavy rains during the monsoon season serve to naturally replenish the basin and flush out the river system. However, the Yamuna basin has long been operating on water deficit through over-abstraction from both surface water and groundwater sources which prevent the natural flushing of sediment from the riverbed and floodplain. Compounding this water deficit further, studies have shown that the Yamuna river basin is drying up and the Himalayan glacier, the source of base flow for the river, will disappear in the next 20 to 30 years (Rai, 2010). Even as the basin is drying up, water supply is limitless. Nearly all river water is diverted away for human consumption. Current reported water demands by sector are based on generous estimates; the larger a city or sector demands, the larger the margin for future allocation (CSE, 2012). Groundwater extraction for irrigation and drinking supplies is dangerously uncontrolled and unmetered. The extent of the basin's water deficit is unclear because there is a gross lack of accounting for water abstraction.

Current management practices, and a lack of understanding the true nature of the system, are accelerating the river basin's demise. During the monsoon season, the river's natural replenishment of floodplains and clearing of sediment is restricted by construction in floodplains, embankments, and barrages along the main river channel.At present the river water is hauled at optimum at the rate of around 220 MLD (million litre per day). This includes Rs 1-1.5 lakh (per day)as electric surcharge, Rs 930,000 as purification cost along with maintenance cost, over head charges, laying of new pipelines (in place of malfunctioning old ones) etc. Water supply system of the city at present involves taxation in fuel, river water, ground water and ecological balance. The water works uses 2000 units of electricity (per month) and have electric meter of 30-40 KW (this is an assumption as primary data was not available). The fact that the quantity of river water available is very meager has already been stated. In the non monsoonal season the average water depth in the Agra belt of Yamuna is just 1 ft which increase to just 4 ft during monsoonal season. At the rate of present haulage and more barrages and haulage in upstream very soon the river will start flowing dry during non-monsoonal season. However with no recharge available aquifers dry out after every 2-3 years after which it is dug more deeply in search of water. At the rate of around minimum of 40-45 litres/person/day (excluding drinking water amount) for domestic uses to around 100 – 300 litres per industry (generally for leather & petha) the enormous haulage done can easily be fathomed. Agra lies in a semi-arid region where the precipitation is low to moderate (628.6 millilitres). With increasing built up space there is little scope of surface water, run off and precipitation infiltration. Thus the resource which has taken years to accumulate is drawn very quickly at the expense of almost no replenishment. Figure 3 shows the ground water scenario of the study area. From the figure it is clear that the region is already in water scarce zone with respect to ground water. Further limitless haulage will render the aquifers non-perennial to dry.

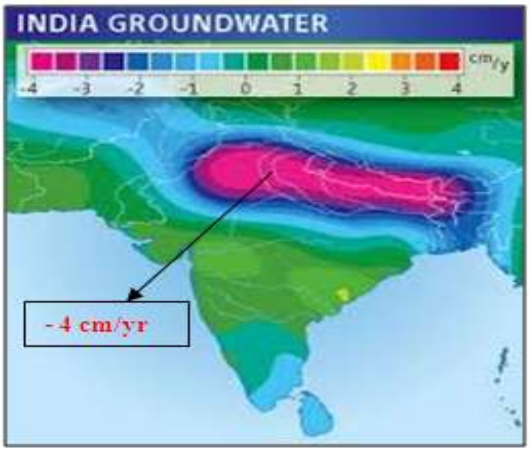

Fig 3: Ground water scenario of Agra (lying in the critical zone)

A minimum river water flow is necessary for aquatic life and the basin's ecosystem. The ecological limit of surface water withdrawals has been reached, and the negative consequences are obvious: loss of habitat and biotic life, pollution build-up, declining water tables, and decreased groundwater recharge. The river in recent years has faced drastic loss in bio diversity. Yamuna dolphins found in upstream have long since ceased existence. Surveying among the city's fishermen community revealed that there has been enormous decrease in the number of fishes caught. Tingra, ritha, baam, rohu, kroti, sol fishes are no longer available. About 15 years back there was ample scope of fishing from Poiya Ghat (Yamuna enters the city from here) to Taj Ganj (the river leaves the city from here). However now with reduced flow fishing is limited only to some pockets.

Conservatory Methods Which Can Be Adopted For Sustainable Development Of Water Resources In The City

In the Millenium Declaration 2000, Govt. across the world pledged to "reduce by half the proportion of people without sustainable access to safe drinking water by 2015" (Pallabi, 2013).That the city does not have any conservative method of water resource management has been proved. The methods applied now are taxing & burdening the already diminished non-renewable resources. Although there has been technological advancement but this is towards aggravating the problem and not towards sustainable development. The city at present is running on a vision less, unsustainable usage of water resources which is harmful for its future.

At present the word "**Integrated urban water management**" has come up. IUWM is described as the practice of managing freshwater, wastewater, and storm water as components of a basin-wide management plan (Tucci et al, 2009). Our suggestions for remodeling the city's water management thus depend on the activities under the IUWM which includes the following. The methods discussed here are not isolated from each other but they are integrated into a common whole.

- **Improve water supply and consumption efficiency:** Before trying to develop new water supply, it will probably be easier to improve the current water sources. Areas with only ground water source of water should be replaced with corporation supply to reduce the load on the same. Pipes should be inspected regularly, since leakages from pipes and sometimes breakage of the same results in huge water waste. There is no current restriction on water withdrawals from the river. A reduction in water allocation to human users can be managed effectively through water demand management strategies.

It is natural human tendency to disregard things which comes free or at subsidized rates. The case is quite similar with regard to the city's population. Wastage of water particularly in the monsoonal and winter season through overflow, use in landscape gardening, over use, defective taps, leaking pipes etc are quite common.

Plate 1: Water wastage in front of a renowned city restaurant: Please note the enormous amount flowing away as "waste water"

In general it can be said that efficiency can be increased by

Domestic Sector: Introduction of domestic water saving devices

1. Water meters on all consumers/ groups of consumers

2. Progressive water tariff structure

3. Auditing of water balance on each distribution system
4. Sewage and other domestic use to be piped out separately

Industrial Sector
1. Progressive water tariff
2. Water recycling facilities
3. Treated urban sewage water for cooling and other processes

River management for Agra catchment area
1. Afforestation and soil conservation particularly along the river bank which will help in increased recharge of the river
2. Treatment before disposal of sewage- At present the river has become a sewerage canal. Proper & efficient treatment of waste water should be done. This will help in the recycling of the river/waste water.

- **Upgrade drinking water quality and wastewater treatment** The corporation supply water available to the city is unsuitable for direct consumption (although it is used by the LIG). The city depends solely on bottled water. More advanced technology is required for purification and detoxification of the supply water so that it can be consumed without putting pressure on the dwindling ground water. Individual rain water harvesting units for every high rise and its simultaneous purification can help solve the problem to a great extent. Cheap natural filters like charcoal, sand, gravel etc can help filter the water for consumption.
- **Increase efficiency of services to sustain operations and investments for water, wastewater, and storm water management and utilizing alternative water sources, including rainwater.**

The constitution of India prescribes that waste water supply & sanitation are state responsibilities and it has the right to undertake their own planning implementation, operation & management of waste & wastewater projects. The work is undertaken at the State level by Pollution Control Board and Public Health Engineering Department and at the city level by metropolitan board and municipal corporations.

With diminishing water reserve worldwide most of the countries practice waste water treatment. In Florida municipal waste water is treated properly and the same is used for ground water recharge. Countries like Israel, Spain, Saudi Arabia etc use treated wastewater. Water is recycled and reused 3-4 times before final disposal. Even in India municipal corporations like Mumbai, Pune, Chennai Coimbatore, Town & country planning department of Uttarakhand etc have made it mandatory for new constructions to have rain water harvesting, waste water treatment plant and water recycling apart from having other optional renewable energy facilities. The study area at present is disposing off single use and sometimes virgin water through sewerage canals to the river which has turned into a huge sewerage drain. The city like the rest of the country is undergoing rapid urban sprawl (Fig 4 & 5) in the fringe area in the form of high rise apartments. This increasing demand is met by the depleting Yamuna and ground water in the absence of any facilities of water recycling, rain water harvesting and waste water treatment. The waste water (both domestic and industrial) after being recycled and treated can be used by the numerous industries, artificial recharge of aquifers, being nutrient rich essential in irrigation (70% of Israel's irrigated agriculture is based on highly purified wastewater), landscape gardening and in rehabilitation of natural ecosystems. This will check over haulage of the already depleting Yamuna and also check direct addition of toxic elements like ammonia (domestic waste) into the river water.

Fig 4: Level of urbanization in 2004

Fig 5: Urban sprawl & increase in the density of urbanization in 2014

Storm water management is the street rainfall runoff collection. This is an important concept in rain water harvesting (apart from roof top RWH). The runoff which otherwise would have enhanced soil erosion and resultant sedimentation in the river bed is used profitably in surface and subsurface (aquifer) recharge. The sandy, loose alluvium soil of the city being porous can act as good recharge area for the underlying aquifer.

- **Engage communities to reflect their needs and knowledge for water management**

In planning operation systems, **water allocation priorities** should broadly be as below, but governed on the basis of local conditions and requirements:

- i) Drinking and domestic use
- ii) Sustaining livelihoods
- iii) Sustaining environment, maintaining river systems and aquatic life
- iv) Industries
- v) Recreation and religious uses

The first three uses have the highest priority but within these, the allocation of water should be decided by the people at the watershed level. For allocation to other uses where bulk supplies are required and where supply to the first three categories is affected, people's agreement would be necessary.

- **Recharge surface (river flow) and sub surface water (ground water)**

The alluvial sandy soil in the Yamuna flood plain has aquifer parameters conducive for recharging the aquifer during a normal monsoon season (Rao et al. 2007). The water flowing through the river Yamuna, the groundwater in river bank storage (flood plain just by the side of the river) and the other water bodies are in dynamic equilibrium (Shekhar and Prasad 2009). It is thus important to assess the desirable monsoon flow in river Yamuna required for proper recharging of flood plain aquifers. The groundwater velocity through the sand in the Yamuna floodplain, at peak flood has been estimated as 2.12m/day. With this velocity, the lateral groundwater recharge beyond the flooded stretch over a period of three months (post peak flood), would be about 200 meters on either side During the peak monsoon flow the river expands to a breadth of ~500 m and recharges the flood plain by gravity recharge. An additional ~400 m is recharged by lateral groundwater flow.

Thus the total width of the flood plain recharged by the river during the monsoon as ~ 1 Km (Soni et al, 2014). At present irrigation water is hauled through submersibles. If small earthen canals connecting the river can be built, it can serve the dual requirement of fetching the extra water into the fields during the monsoon and also act as good recharging zones for groundwater through seepage and infiltration. Further these canals will also act as catchment zones for the water thirsty Yamuna. The excess water which otherwise would have run-off and enhanced soil erosion and subsequent sedimentation in the river bed can be used profitably through this. The soil type of Agra will enhance easy recharge being loose and sandy.

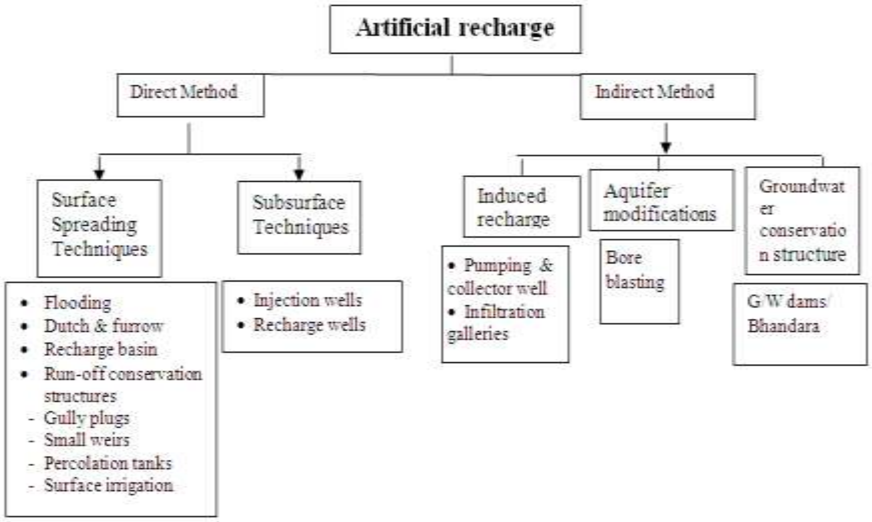

Fig 6: Methods of artificial recharge that can be undertaken in the study area.

- **Establish and implement policies and strategies to facilitate the above activities**

Local government and municipal corporation after formulating necessary legislative measures should see to it that the same is been followed. Regular visits to industries and high rises are a must to check the implementation of the legislative measures. Imposition of **fines for the wrong doers and proper legislation** is required to save the river.

REFERENCES

[1]. CPCB, Water quality status of Yamuna River (1999–2005). Central Pollution Control Board, Government of India, 2006, p. 136.
[2]. Center for Science and the Environment (CSE) of India's Environment Report: *Excreta Matters (71 cities: a survey)*.2012
[3]. Jha, P. K., Subramanian, V. and Sitasawad, R., Chemical and se-diment mass transfer in the Yamuna river – a tributary of the Ganges system. *J. Hydrol*., 1988, **104**, 237–246.
[4]. Malik et al. (2014), Heavy metal pollution of the Yamuna river: An introspection, International Journal of Current Microbiology and Applied Sciences, 3 (10), 856-863
[5]. Mahapatra, October 30, 2012: "CPCB test revealed that river water hardly contained dissolved oxygen, vital for survival of aquatic life." as told to" *The Economic Times*
[6]. Pallabi Hazarika (2013), Sustainable Development initiatives towards waste water management in Delhi, International Journal of Social Science, 1 (1), 24-32.
[7]. R,K. Rai, Alka Upadhyay and C.S.P. Oiha. 2010: Study found an increasing trend in the gradual delay in the onset of the monsoon season in the Yamuna River basin, and an overall falling trend in annual rainfall, monsoon rainfall, annual rainy days, monsoon rainy days, since 1951.
[8]. Rao, S.V.N., Kumar, S., Shekhar, S., Sinha, S.K. & Manju, S. (2007), Optimal pumping from Skimming Wells from the Yamuna river flood plain in north India. Hydrogeology Journal 15: 1157-1167.
[9]. Singh, Shivani. March 11, 2012. "Make a drain of a river, throw crores down it" H*industan Times.*
[10]. Shekhar, S. & Prasad, R.K. (2009), The groundwater in Yamuna flood plain of Delhi (India) and the management options. Hydrogeology Journal 17: 1557-1560
[11]. Soni V, Shekhar S, Singh D (2014), Environmental flow for the Yamuna river in Delhi as an example of monsoon river, Current Science, 106 (4), 558-564.
[12]. Tucci, C., Goldenfum, J.A., Parkinson J.N. (2009). "Integrated Urban Water Management: Humid Tropics". CRC Press.
[13]. www.rainwaterharvesting.org/crisis/river-yamuna.htm