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A Brief History of Public Water Supply System in Aziawl City, Mizoram, India

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Abstract:

Water is one of the most valuable natural resources. It plays an important role in the well-being and development of human society. Throughout the human history, water has been looked upon as something intertwined with man. No other natural resource has had such an overwhelming influence on human history as the water had. Human dispersal and concentration is governed by availability of water resource on the surface of the earth. Human settlements are invariably situated on or near sources of water. Access to sources of water or to make available water to human settlements, particularly for domestic purpose, has been a primary task right from the early times. However, due to increase of population over the years the human settlements have increased in number and size and thus put pressure on the limitedly available water resource. This has led to lack of natural supplies and introduction of artificial methods of securing the requisite quantity of water. Consequently, man to meet his domestic requirements has been tapping different sources of water. Hence, a brief history of public water supply system in Aizawl is presented.

Keywords: Tlawng, Tuirial, Town Emergency, Rainwater, PHED.

Introduction: Major human settlements could initially develop only where fresh surface water was plentiful, such as near rivers or natural springs. Throughout history, people have devised systems to make getting water into their communities and households and disposing of (and later also treating) wastewater more convenient. During the Neolithic era, humans dug the first permanent water wells, from where vessels could be filled and carried by hand. Wells dug around 6500 BC have been found in the Jezreel Valley (Eli, 2012). The size of human settlements was largely dependent on nearby available water. Archaeological excavations find early human settlements located at sites with reliable sources of drinking water nearby (Bromehead, 1942). The availability of water for drinking from springs, streams or lakes often meant that plants, animals and other critical goods would have been nearby, as well. Excavations from the Neolithic time have also found a striking correspondence between settlements and wells (Malmberg, 1980). As societies developed from hunter/gatherer economies to more advanced grazing, the need for secure, abundant supplies of water became even more important.

Management of drinking water was central to urban planning in early settlements, as well. Thus one can find examples of sophisticated water management in virtually every archaeological excavation of ancient civilizations. Water storage basins with minimum storage capacities of 10,000-25,000 gallons of water have been excavated in the Mesa Verde region of the American Southwest (Robert Wilshusen et al., 1997). Large collection and storage structures have been uncovered throughout the Maya Lowlands (Scarborough and Gallopin, 1991). Though half a world away, cisterns and wells carved from the rock have been found in excavations at Ebla, in Syria, dating from 2350 B.C. Even earlier water storage sites have been found at Jawa, in north-eastern Jordan, dating from the fourth millennium B.C. Archaeologists suspect that such reservoirs were important features of town defenses, providing a secure supply of water in case of siege. The massive cisterns at Masada, high above the arid Dead Sea, proved critical to the multi-year resistance against the Romans. The Minoan civilization in Crete had flushing toilets and domestic water as early as 1700 B.C., while tunnels directing water from reservoirs and plumbing have been identified from ancient sites in Iran, Palestine and Greece (Kennedy, 1995). Perhaps the most impressive ancient water engineering in the Americas was constructed by the Incas at Machu Picchu, who faced the challenge of moving water from a distant spring to their capital, located at over 7,000 feet. Sloping canals delivered water through agricultural terraces to the Emperor's residence and then, through a series of 16 fountains, down the mountain slope to the city's residents (Jeff, 1990).

There are several astonishing examples of urban water systems from about the mid-third millennium BC. Mohenjo-Daro, a major urban centre of the Indus Civilization, developed a sophisticated system for water supply and sewage. Water came from more than 700 wells and supplied not only domestic demands but also a system of private baths and a Great Bath for public use (Jansen, 1989). The Mesopotamians were not far behind (Adams, 1981). An example is the city of Eshnunna (80 km northeast of the present Baghdad) dated in the same period, where archaeological excavations exposed sewers constructed of brick, with laterals connecting to houses (Gray, 1940). In the Sumerian city of Nippur the excavations exposed clay pipes as well as tee- and angle-joints. Rainwater harvesting and collection in cisterns for urban water supply was practiced at about the same period in Jawa in northeastern Jordan (Abdel Khaleq and Alhaj Ahmed, this issue). Another collection system, this time for groundwater, was developed in Persia, again in the same period (Hassan, 2003). This is the well-known "qanat" – a subterranean system of tunnels connecting wells and dug using vertical shafts, designed to collect and transport water, sometimes over long distances, from highlands to low-lying farming land.

There is little and very sketchy historical information about the early settlement at Aizawl. It is, however, believed, that in 1804 Thahdo Chief Henrova, ruled over the area what is today known as Aizawl from the present Mission Vengthlang village council. However, the administration came under a Sailo Chief Lalsavunga, approximately between 1810 and 1821, who ruled from Hlimen village at the southernmost part of the present Aizawl. Later, around 1877 another Sailo Chief, Thanruma, ruled over Aizawl till 1887.

From these historical accounts, it appears that Aizawl covered only an area between the present 1st Assam Rifle ground in the north and Tuikhuahtlang in the south hardly 1.5 km apart during the rule of Thanruma, who ruled from Tanhril village.

From a small-fortified post established by Mr. Dally of Assam Police in 1890, Aizawl has become the largest urban centre as well capital of Mizoram. The ever-continuing increase of population has already been posing serious challenges in respect of the provision of service lands, shelter, water supply, power supply, storm drain system, garbage disposal, and many other things. It has reached a stage where in population is likely to continue to grow and in the absence of proper economic growth, infrastructure planning and management of spatial arrangement and restructuring, it is bound to have a very serious impact on the life, health and working environment.

Very little is known about the earlier demographic characteristics not only at Aizawl, but also in the whole of Mizoram as no census could be conducted before 1951 in the erstwhile Lushai Hill District of Assam. The population in early years since 1890 increased or decreased depending on the political equation and will among the British troops and the Mizo chiefs who ruled over Aizawl and its hinterland villages. It also varied depending upon the agricultural condition and hostilities among Mizos' that had prevailed in the past. However, since 1901 the population has been on the increase although at a small rate in the earlier decades of the 20th Century.

The spectacular growth of population may be attributed to many factors. It has resulted in the concentration of population in the town and expansion of its area. No doubt, the phenomenal increase of population may largely be attributed to the expansion of the urban area, but the most important cause of spectacular population growth, especially after 1966, has been immigration. Many natural and socio-political factors are responsible or huge inflow of people to Aizawl. The great famine (Mautam) of 1960, which brought havoc to already poor agricultural economy of the Lushai Hills, forced people from rural areas to migrate to the only urban centre in search of livelihood. Moreover, M.N.F (Mizo National Front) uprising in 1966 and its policy of forcible recruitment of youngsters in its cadre caused further migration to Aizawl as people from rural areas felt safer nearer the seat of the government, protected by military and para-military forces. Subsequently, the army resorted to grouping of villages in order to counter the M.N.F insurgency. Uprooted from their ancestral villages many a number made Aizawl their permanent habitat. In addition, in 1960, the government introduced a policy of grouping and re-settling of villages near the road and over 35 per cent of population of the state has shifted to the new periphery of the capital, new sites for security reason during 1966-1970.

Recognition of Mizoram as Union Territory in 1972 and gradual cessation of hostilities led to the more conducive living condition in the state in particular and Aizawl especially. Moreover, new administrative set up at Aizawl attracted people not only from within but also from the outside the state. As a result, it experienced more than doubling of its population between 1971 and 1981 when population grew to a magnitude of a little over 57

per cent. The continuous area extending up to Sihphir in the north, Hlimen in the south and Lawipu, Tanhril, Sakawrtuichhun in the west and Zuangtui and Zemabawk in the east were identified as the Aizawl Urban Agglomeration in the Census of 1991, extending over approximately 128.98 sq km. The population of Aizawl has gone up very rapidly since 1951. The population has more than doubled in 1961, i.e., 14257 persons, re-doubled in 1971 (31740 persons), multiplied 17 times in 1981, i.e., 74493 persons and again multiplied 20 times by 1991. In addition, the population has jumped up again to 2, 28,280 and 293416 in 2001and 201 Census, respectively. In terms of percentage of rate of growth during 1961-1971, the population grew at 122.63 per cent and during 1971-1981 at 134.70 per cent. Between 1981-1991, the rate of growth was 108.40 per cent and between 1991-2001 it was 47.05 per cent. The highest growth rate has taken place during 1971 to 1981 however, moderate or stable growth rate has occurred from 1981. In 1961, the density of population was about 1100.92 persons per sq km. Though the area has expanded in 1971, the density of population still increased to 1729.70 persons per sq km. Massive expansion of area occurred in 1981 resulting to decrease in the density of population, i.e., 677.2 persons per sq km. Subsequently, the density of population again increased to 1203.6 persons per sq km in 1991 and 1769.9 persons per sq km in 2001, again it has increased to 2274.9 in 2011.

Drinking water is one of the primary human needs. Water is required in households' for numerous purposes, e.g., for cooking, drinking, bathing, and washing utensils, cloths etc. Water, though a gift of nature, is becoming scarce, insufficient, and unsafe for human consumption. A stage has come when humanity finds it necessary to make collective efforts to conserve the gifts of nature assiduously, even for its survival. Protection of sources of water and water quality will indeed become more critical with more and more cases emerging of severe shortages that directly affect daily life, resulting in multi-dimensional crisis particularly when demand for water increases dramatically as compared to not so elastic supply position. Fast population growth with accelerated growth of the cities, combined with scarce water supplies means that the governments all over the world often cannot supply enough water to meet demand. Therefore, the present study aims to investigate a brief history of public water supply system in Aizawl city.

Study Area: Aizawl, the capital of Mizoram state, is situated in on the hillcrests, steep slopes and small valleys. It is located on a north-south elongated ridge, which acts as the main hill from which many small ridges and valleys are extending towards the east and west directions. The topography is highly undulating and rugged. The unique physical attributes of this rugged land are marked by extreme fragility and frequent landslides, limited land space, steep slopes and lack of accessibility. The city reveals a rapid and uncontrolled growth pattern with multi-storey settlements that has mushroomed unplanned on highly risk prone slopes. The altitude varies from 120 m to 1400 m above mean sea level. It falls between 23º 40' N to 23º 50' N latitudes and 92º 40' E to 92º 49' E longitudes (Fig. 1). It covers an area of about 128.98 sq km, and as per Aizawl Municipal Corporation Report 2020, the population is 3,59,829 persons. There are a number of streams in and around

Aizawl City, but none of them is dependable for providing adequate water. The only dependable source is river Tlawng located more than 1,000 m below the city.

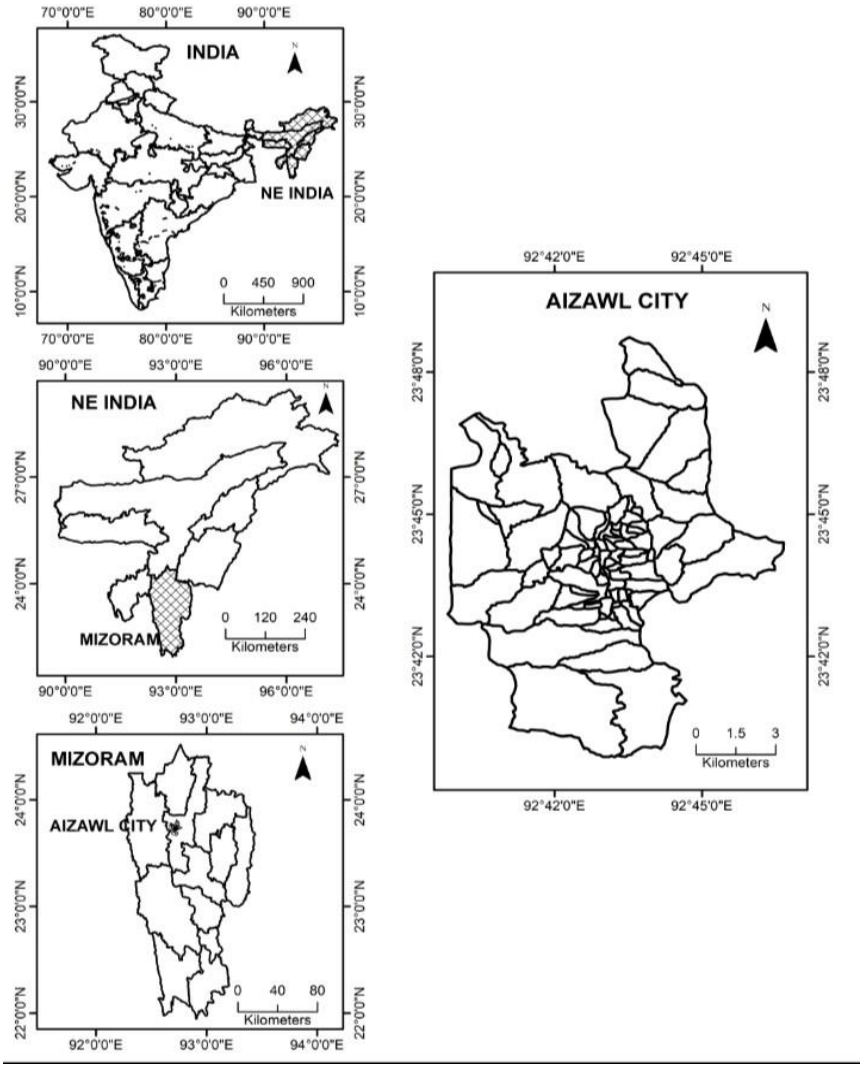

Fig. 1. Location of Aizawl City

Discussion: The prime source of water is the terrestrial precipitation mainly in the form of rain. Its availability in the form of surface runoff and ground water is also dependent upon the rainfall pattern, geological structure, and landforms of the area. As the population started increasing due to manifold factors of economic development and invention, man started tapping the water sources both surface and ground for survival, but the problem is that water in these sources is depleting due to various reasons. Aizawl, like most of the hill towns face acute problem of water supply during the dry winter season and early summer.

Habitations in the hilly terrain have interwoven with them a tale of springs and natural seepages, and the study area is no exception. If there are hamlets around in the hills there must have been water at a point of time when people inhabited these. Traditionally, water from the springs and seepages from the hill slopes is collected in artificial reservoirs (Tuikhur), and used as the prime source of domestic water in the study area. The water related needs of the people in the study area were for generations being met by these natural sources of water. However, the discharge of water in these sources has been depleting over the years; many have dried up while many more have become seasonal due to increasing population, neglect of the recharge areas and changes of land use. In order to solve the drinking water problem in the study area the State government has been implementing several schemes, millions of rupees have been pumped in, but the situation is far from satisfactory. Therefore, in order to understand the existing types and distribution of water sources in the study area, it is essential to highlight brief history of public water supply system in Aizawl.

The British administrator A.G. McCall made the first effort for the Aizawl water supply scheme in the year around 1891 to 1892. In 1897 Lt. Col. J. Shakespeare and Capt. Loch made further progress for the water supply schemes. A little tank was constructed just below the Superintendent's garden (now Near Mizoram Planning Board building) following the effort made by Mr. Porteous but could not hold water due to seepage and porosity of the soil. Later water tanks were made at different places like one at Quarter Guards, another at Sikul Sen, one at Babutlang and another one near the present Agriculture Directorate building.

In 1900, when the British first set their foot in Aizawl, harvesting of rainwater from the abundant rains was sought as the easiest solution to bring water to the residents. During that time an underground masonry reservoir of 12 lakh gallons was constructed at Tuikhuahtlang on the hillock at Aizawl. A sloped roof of corrugated galvanized iron sheets on timber frames was constructed around the reservoir for rainwater catchment. This was the only water supply of Aizawl for government officials till the year 1973. From that time people have been practicing rooftop rainwater harvesting to meet their domestic water demands. However, the water collected in the reservoir used to be distributed primarily to the government employees, thus water remained a scarce commodity for the general public. Similarly, two water reservoirs having 18-lakh gallons capacity were constructed at Laipuitlang on the hillock of northern part of Aizawl during 1953-1954 for collection of rainwater, but that was not sufficient for solving the problem of water supply. That was the only centralised collection and distribution of water at that time. This served as the only water source for several years and rooftop harvesting of rains became an increasingly popular practice.

1. **Aizawl Water Supply Scheme:** In April of 1961, the PHED (Public Health Engineering Department) section was established in Aizawl under Karimganj Sub-Division of Shillong, PHED Division. In the same year, survey and investigation of reliable sources of water for providing permanent water supply to Aizawl was

carried out. Initially the River Chite and River Ser were surveyed but they were found inadequate. On further investigation, pumping of water from River Tlawng through a static head of 1,037.92 m was found to be the most dependable source. In 1964, the quest for rainwater harvesting was abandoned and the first piped water scheme to supply 67.5 litres per capita per day (lpcd) commenced.

The Aizawl Water Supply Scheme was launched to lift water from River Tlawng to a height of 1,037.92 m in Tuikhuahtlang reservoir through seven stages using 145 H.P. diesel engine pumping sets and was completed in 1972. The project estimate was prepared in 1963, based on the 1961 census, which stood as 14,257 persons covering an area of 12.95 sq km. The project was prepared on the estimated population of 20,000 persons. The rising main is 150 mm diameters G.I. pipes and the designed capacity of the pumps is 350 gallon per minute. The designed capacity per day is 5 lakh gallons at estimated 24 hours pumping. However, the designed pumps capacity is not reached due to shortage of diesel, which prevents 24 hours pumping programme. It is also reported that the designed pump capacity of 350 gallons per minute is not achieved. Hence, out of the total designed pump capacity of 5 lakh gallons per day only about 1.50 lakh gallons can be raised per day.

Aizawl Water Supply Scheme had been laid on a crash basis without following conventional distribution designed as such the distribution of water is not uniform. The scheme also covered only the central localities, leaving the localities, which came up after 1973. Later, some localities were connected. All the distribution system originates from the two main reservoirs at Tuikhuahtlang and Laipuitlang. This piped water system still exists but augmentation of this scheme is taking place to fulfill the ever increasing demand of water in Aizawl.

2. **Aizawl Town Emergency Water Supply Scheme:** In 1971, Aizawl Town Emergency Water Supply Scheme was initiated by pumping water from a river called Company Lui to Laipuitlang reservoir through four stages pumping using 20 H.P electric motors. The rising main is 80 mm diameters G.I. Pipes and the designed pump capacity is 45 gallons per minute. Due to shortage of power the scheme could not functioning properly and hence not dependable. It is run only if and when the power is available. Even during pumping hours, the pump capacity is much less than the designed pumping capacity.

3. **Water Supply by Truck Carriage:** Water Supply by Truck carriage is resorted to especially during dry season. In this process, water is carried in tanks by motor vehicles by loading 1500 to 1800 gallons of water. Water is collected from River Tuirial which is about 28 km due west from Aizawl and then distributed without proper treatment to those who are not getting water from piped supply. The water quantity supplied through this method varies from season to season. The average quantity of water supplied from February to May is about 126,000 gallons per day and from June to January it is about 90,000 gallons per day.

4. **Greater Aizawl Water Supply Scheme:** Drinking water supply and sanitation are the subjects of State government; these are included in the eleventh schedule of the Constitution of India. Though the Central government has some leverage in general, it does not have enough power to coordinate institutional issues (GoI, 1986). In the study area, the State Public Health Engineer Department (PHED) is the responsible department for providing water supply. The PHED, Mizoram was bifurcated from the State Public Works Department (P.W.D) since 3rd August 1983. Since then the department has been functioning as a full-fledged department. The department has been dealing mainly with social services in water supply and sanitation sector.

The present piped water supply was augmented during 1983 by formulating Greater Aizawl Water Supply Scheme Phase-I by tapping River Tlawng for a population of 80,000 with a capacity of 10.8 million litres per day (MLD). This scheme involves pumping of water from River Tlawng with a total static head of 1037.92 m through two stages, which is the second highest water supply scheme in India next to Simla, and commissioned in December 1988. It resulted in exorbitantly high operation and maintenance costs and became a major concern for the sustainability of the project. By the time the project was completed the population outgrew the estimated capacity.

The Greater Water Supply Scheme Phase – I consists of pumping of raw water from River Tlawng to the inlet of water treatment plant near the river through 350 mm (ERW of API quality) pipeline. The length of pumping main from raw water pump house to treatment plant is about 150 m and the elevation of both the places is more or less similar. Clear water is pumped from treatment plant complex to the clear water reservoir at Lawipu with an elevation of 552.28 m using 350 mm (ERW of API quality) pipeline. Moreover, from clear water reservoir at Lawipu water is again lifted to the main reservoir at Tuikhuahtlang to a height of 485.64 m. The total length of pumping main lines from treatment plant to the main reservoir at Tuikhuahtlang is 7252 m with a total static head of 1037.92 m. These pipelines were laid over the ground following the shortest alignment and nearest from the approach road. The Greater Aizawl Water Supply Scheme Phase-I was designed and installed decades earlier and now highly inadequate to cater the needs of the rapid increasing population. The problem gets further aggravated due to aging and machineries have worked beyond its life span.

As the study area is a hilly, the profile is very much undulating and the population is very much scattered, uniform supply of water to the consumers from one or two reservoirs is not possible. As such, service reservoirs are constructed at different places to maintain uniform distribution of water to the consumers. However, in some localities there is no suitable land to construct service reservoir. Service reservoirs are usually called Zonal Tanks.

Water drawn through pumping main is discharge into an old storage reservoir of 12.00 lakhs gallons capacity at Tuikhuahtlang. It was constructed in 1900, with cement concrete underground reservoir but without outlet, partition wall and cover since it is for collection

of rainwater only. Thence, this reservoir has been repaired to prevent leakages and has been provided outlet and scour pipes at the bottom for cleaning. A partition wall has also been made to facilitate cleaning of one compartment without emptying the whole tank. Even cover has been provided to prevent water from too much evaporation and pollution from impurities brought by wind. However, the capacity of the reservoir remains the same.

There are two other main reservoirs at Laipuitlang with capacities of 12.00 lakhs and 6.00 lakhs gallons side by side. They are of trapezoidal shape and constructed during 1953 to 1954 with cement concrete with nominal RCC beam at the bottom, for collection of rainwater. They are located at the crest of Laipuitlang. An independent line was drawn from the main reservoir at Tuikhuahtlang to the other reservoirs at Laipuitlang. Since the latter is higher than the former by 23 m, therefore booster pumps were installed at Chanmari village council to pump water. Booster pump consists of two-Vertical Turbine Pump driven by electric motors and one diesel engine as stand by. This inter-connection line is drawing water from the main reservoir at Tuikhuahtlang to distribute in the northern parts of the City and there is no branch line. The inter-connection line comprises of 355.6 mm (OD) ERW, API quality pipe. Hence, separate feeding main lines were laid from the reservoirs at Laipuitlang to feed zonal tanks in the northern parts.

There are twenty-two zonal tanks distributed in eighteen different village councils. Zonal tanks are pressed steel tanks of fourteen numbers and R.C.C tanks of eight numbers with a capacity varying from 225,000 litres to 900,000 litres and the total capacity is of 12,500,000 litres. Each zonal tank covers particular zone for uniform distribution of water. The area and number of population covered by each tank differs from place to place. From the two reservoirs at Tuikhuahtlang and Laipuitlang, each zonal tank is connected by feeding main line. From Laipuitlang reservoir, feeding main line branches out to seven zonal tanks in the northern part of the study area. The other fifteen zonal tanks have been directly connecting from the main reservoir at Tuikhuahtlang. The feeding main lines connected to twenty-two zonal tanks from the two reservoirs are 2,863 m long of CI pipes of varying sizes from 200 mm to 350 mm diameter and 15,182 m long of GI pipes of varying from 80 mm to 150 mm diameter.

Moreover, 667 Supply Tanks of varying capacities from 6,000 litres to 10,000 litres are distributed in different village councils to maintain uniform distribution of water. Separate distribution lines have been laid from each zonal tank to the supply tanks in adequate pressure at various places to maintain somewhat equal pressure and uniform supply of water to the consumers. The distribution pipelines laid from the zonal tanks to supply tanks are medium quality galvanised iron pipes of varying sizes from 40 mm to 150 mm diameter with a total length of 122,080 m. The supply tanks act as check for the quantities to be supplied to house connections and public taps.

To enhance the water supply from Greater Aizawl Water Supply Scheme Phase – I, the state government formulated another major project in 1998. This is the Phase II of the

Greater Aizawl Water Supply Scheme. The combination of Aizawl Greater Water Supply Scheme Phase I & II now pump water 22.99 MLD.

Conclusion: The future of human settlements, especially the cities, will largely depend on the availability of adequate water in sufficient quantity and safe quality. Water is not an internationally traded commodity to an extent even remotely comparable to oil and the availability of water in a distant part of the world is of no great relevance to a water short country or region. Almost all water situations and problems are local or regional in nature. Therefore, the needs of a place or region for fresh water have to be met from its own water sources. Water problem in cities has become very serious in recent years. No city, or even any human settlement, can exist without water. Both its quantity and quality are important, as it does not have any substitute. Everywhere, cities have grown in both size and considerable population. Demand for water has been accelerating in cities because of rapid population growth and increase in per capita consumption due to development and change to a life style characterised by water consumption in larger quantities. The practice of on-site uses of water, i.e., washing and bathing in springs and rivers has been fast giving way to that of withdrawal uses through running water taps in flush latrines, bathrooms and kitchens. While on the one hand, the water requirement has been increasing rapidly, on the other the water resource potential is being adversely affected in terms of both quantity and quality. Expansion of concrete structures has been shrinking open spaces required for percolation of water and thus reducing the quantity of ground water recharge. At the same time, use of water bodies as dumping grounds for all sorts of refuge and defection near them have been polluting both the ground and surface water. Therefore, maintenance of adequacy of good quality water supply should be a major component of any city planning.

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