

Introduction

1.1. Importance and Necessity for Planned Water Supplies

Water is a chemical compound and may occur in a liquid form or in a solid form or in a gaseous form. All these three forms of water are extremely useful to man, providing him the luxuries and comforts, in addition to fulfilling his basic necessities of life. Everyone of us knows how important and precious the water is. Whenever there is no water in our taps, we become helpless. No life can exist without water, since water is as essential for life as air is. It has been estimated that two-third of human body is constituted of water. Water is absolutely essential not only for survival of human beings, but also for animals, plants and all other living beings. Further, it is necessary that the water required for their needs must be good, and it should not contain unwanted impurities or harmful chemical compounds or bacteria in it. Therefore, in order to ensure the availability of sufficient quantity of good quality water, it becomes almost imperative in a modern society, to plan and build suitable water supply schemes, which may provide potable water to the various sections of community in accordance with their demands and requirements. The provision of such a scheme shall ensure a constant and a reliable water supply to that section of the people for which it has been designed. Such a scheme shall not only help in supplying safe *wholesome** water to the people for drinking, cooking, bathing, washing, etc. so as to keep the diseases away and thereby promoting better health ; but would also help in supplying water for fountains, gardens, etc. and thus helping in maintaining better sanitation and beautification of surroundings, *thereby reducing environmental pollution*. Besides promoting overall hygiene and public health, it shall ensure safety against fire by supplying sufficient quantity of water to extinguish it. The existence of such a water supply scheme shall further help in attracting industries (since industries require large amounts of water) and thereby helping in industrialisation and modernisation of the society, consequently reducing unemployment and ensuring better living standards. Such schemes shall, therefore, help in promoting wealth and welfare of the entire humanity as a whole.

*The water which is safe and potent for drinking to human health is referred to as **wholesome water**. Such a water will *neither* contain any chemicals or impurities in excess of which they may harm a human body *nor* any harmful bacteria or microorganisms. A water which is **safe** due to absence of harmful bacteria may or may not be wholesome, but wholesome water will always be safe.

1.2. Financing of Water Supply Schemes and Their Development in India

Huge amounts of money is required for planning, designing and executing a city water supply scheme. The first investment as well as the RMO (*i.e.* Running, Maintenance and Operation) charges, along with depreciation and interest charges, must be returned by the beneficiaries in the form of **revenue returns** from the sale of water, which is generally measured by meters. It is, therefore, necessary to work out fair and reasonable charges for the sale of treated water, in addition to designing the project.

In a developing country like India, the problem of availability of funds for the first investment is sometimes very difficult to be solved, as money is required for financing various other important projects such, as those of flood control, education, defence, health, etc. In spite of such handicaps, the Indian Govt. has done fairly well by spending about 1—3% of their total plan outlays on “Water Supply and Sanitation Sector”, as reflected in Table 1.1.

As a result of such investments, India has been able to cover about 84% of its urban population (which is about 30% of the total population of the country) with safe drinking water supplies, although such supplies are quite limited*. Moreover, the scene on the rural sector still remains grim and at many of our villages, the village folk are till today fetching and bringing water on their heads from distant wells or ponds, and there is no provision for testing or purifying those waters. Even in towns, where municipal committees do exist, there are no sufficient provisions even for testing and purifying the drinking water supplies except using chlorination at certain places.

Let us, therefore, in all sincerity, appeal to the Indian Government that it should try to further curtail expenses on luxurious livings and should invest that money on improving the town and village water supplies, as also the sewerage and drainage arrangements, so that our villages, towns and cities no longer remain heaps of filth, dung and garbage. The Indian Socialistic Government under the leadership of Late Pt. Jawahar Lal Nehru and his daughter Smt. Indira Gandhi, had definitely achieved some remarkable successes in the fields of irrigation, education, atomic energy, defence, etc. but unfortunately the field of public health engineering remains somewhat neglected. Let us hope that this sector will also get its enhanced due share and a good treatment from the hands of our planners, as most of the money being spent on medicines and under health sector etc. can be saved, if unadulterated food, proper sanitation, better hygiene, and above all, *safe and wholesome water*, are made available to the general public.

1.3. Pricing of Municipal Water Supplies

Water supplied by the municipalities to urban and rural areas for domestic, commercial, or industrial uses has to be priced in such a way that the RMO (Running, Maintenance and Operation) costs as well as the depreciation and interest charges on the capital investment is returned by the beneficiaries in

*None of the metropolitan cities of India (including Delhi) is being supplied water for 24 hours of the day. Even Kolkatta, where the first modern water supply system was installed in 1870, faces shortage of water and supplies water only for 10 hours a day ; while Delhi supplies hardly for 6 hours a day.

Table 1.1. Planwise Investment in Water Supply and Sanitation Sector in India

Plan Period		Total Public Sector Plan Outlay/ Expenditure Rs. Crores	Plan Outlay/ Expenditure under Water Supply and Sanitation Sector		Plan Outlay/ Expenditure for Urban Water Supply Sanitation		Plan Outlay/ Expenditure for Rural Water Supply and Sanitation	
			Amount Rs. Crores	Public Sector Outlay, %*	Amount Rs. Crores	Public Sector Outlay**, %	Amount Rs. Crores	Public Sector Outlay***, %
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
First Plan (1951-56)	Outlay Expenditure	3360.00 1960.00	49.00 11.00	1.46 0.56	43.00 8.00	1.28 0.41	6.00 3.00	0.18 0.15
Second Plan (1956-61)	Outlay Expenditure	6750.00 4672.00	72.00 74.00	1.07 1.58	44.00 44.00	0.65 0.94	28.00 30.00	0.41 0.64
Third Plan (1961-66)	Outlay Expenditure	8573.00 8576.00	105.70 110.17	1.23 1.28	89.37 91.34	1.04 1.07	16.33 18.83	0.19 0.22
Annual Plans (1966-69)	Outlay Expenditure	6664.97 6625.40	106.42 102.70	1.60 1.55	N.A. 73.53	N.A. 1.11	N.A. 29.17	N.A. 0.44
Fourth Plan (1969-74)	Outlay Expenditure	15902.00 15778.80	437.00 458.90	2.75 2.91	282.00 250.90	1.77 1.59	155.00 208.00	0.99 1.32
Fifth Plan (1974-79)	Outlay Expenditure	39303.49 39426.20	1030.68 1091.60	2.62 2.77	549.44 539.51	1.40 1.37	481.24 552.09	1.22 1.40
Annual Plan (1979-80)	Outlay Expenditure	12549.63 12176.50	430.22 395.28	3.43 3.25	197.93 148.99	1.58 1.22	232.29 240.39	1.85 1.97
Sixth Plan (1980-85)	Outlay Expenditure	97500.00 1,09,291.70	4047.00 3997.78	4.15 3.66	1766.68 2334.53	1.18 2.14	2280.32 1663.45	2.34 1.52

* $\frac{\text{Col. 4}}{\text{Col. 3}} \times 100$; ** $\frac{\text{Col. 6}}{\text{Col. 3}} \times 100$; *** $\frac{\text{Col. 8}}{\text{Col. 3}} \times 100$.

Table 1.1. Contd.

Plan Period		Total Public Sector Plan Outlay/ Expenditure Rs. Crores	Plan Outlay/ Expenditure under Water Supply and Sanitation Sector		Plan Outlay/ Expenditure for Urban Water Supply Sanitation		Plan Outlay/ Expenditure for Rural Water Supply and Sanitation	
			Amount Rs. Crores	Public Sector Outlay, %*	Amount Rs. Crores	Public Sector Outlay**, %	Amount Rs. Crores	Public Sector Outlay***, %
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Seventh Plan (1985-90)	Outlay Expenditure	1,80,000.00 2,19,029.23	6522.47 7093.13	3.62 3.24	2965.75 2557.81	1.65 1.17	3556.72 4535.32	1.98 2.07
Annual Plans (1990-92)	Outlay Expenditure	1,37,033.15 1,33,834.85	4427.29 4391.48	3.23 3.28	1721.37 1693.69	1.26 1.27	2705.92 2698.29	1.97 2.02
Eighth Plan (1992-97)	Outlay	4,34,100.00	16711.03	3.85	5982.28	1.38	10728.79	2.47

* $\frac{\text{Col. 4}}{\text{Col. 3}} \times 100$; ** $\frac{\text{Col. 6}}{\text{Col. 3}} \times 100$; *** $\frac{\text{Col. 8}}{\text{Col. 3}} \times 100$.

the form of revenue returns from the sale of water. From good economics point of view, there should be no under-pricing and subsidies involved in such water supply schemes. However, in a poor and developing country, the rates for domestic supplies are to be kept lower than the rates for commercial uses. Similarly, the rates for commercial uses should be lower than the rates for industrial uses. Although, fixation of such *differential rates for various uses* is permissible, yet the rates for water supplied should not be too low, as not to offer any incentive for saving and conserving water. When water rates are heavily under-priced, the consumers waste water by litres, as no one has the real idea of the real cost spent by the Govt. in supplying water. The Govt's accounts also don't reflect the true value of water lost in transits and thefts ; and hence when measures are taken to plug the losses by preventing supply loopholes, it appears that the cost spent on these measures is more than the cost of water saved, which, in fact, is a total misnomer. Low water rates, thus, bring water management on a low priority area, and leads to alround wastage and mismanagement of water supply schemes.

The actual prevailing water rates in India for municipal supplies are, in fact, abysmally low, when compared to the global standards. There are no regulators to compute and fix the economical and justified water tariffs, and the State Govts. do fix the water rates on adhoc basis, without any rational computations for affecting recovery of O & M charges & capital investments. What to talk of recovery of depreciation & interest costs on capital costs, the rates are usually too low, as even not to recover the O & M charges alone. Although, no official estimates have been made to compute the tariff levels, which will allow full recovery of operation, maintenance and capital costs ; yet various expert analysis have suggested a tariff of ₹ 15/- (\$ 0.3) per kL (cu. m) for the treated water supplied through piped supplies. As compared to this economic rate of ₹ 15/- per kL, the existing rates in the country vary from about ₹ 0.01 per kL to about ₹ 3.60 per kL over most of the States of India, except for Mizoram (where minimum rate is ₹ 10/- per kL), as can be seen from the prevailing domestic water rates given in Appendix Table A-1. From this table, it can be seen and inferred that the rates fixed for domestic water supplies in most of our States are on extremely low side. Even for the metro cities, the water rates, on an average, are fixed at not more than about ₹ 1.50 per kL, *i.e.* @ about \$ 0.03 per kL. Although the rates fixed for industrial water supplies are higher (Appendix Table A-2), yet even this rate averages to around ₹ 12/- per kL in metros and ₹ 5/- per kL in smaller cities, much below the **cost recovery tariff of about ₹ 15/- per kL (\$ 0.3)**. Appendix table A-3 reflects the water rates prevailing in various countries of the World in U.S. dollars (\$) per kL, which reflects as to how abysmally low Indians pay for their water supplies, in comparison to other countries.

There, therefore, exists an urgent necessity in India to rationalise the water rates, and provide meters to bill the consumers on their actual consumption, rather than charging them an adhoc monthly basis, which is being done in several States. A minimum economical rate of ₹ 6/- per litre has been suggested to be fixed by NGO—PPIAF (*Public-Private Infrastructure Advisory Facility*), which can be afforded even by the poorest of the families. In any case, there exists an urgent need to fix **regulators** to work out economic water

terriffs, keeping into consideration the cost of providing public water supplies, and economic conditions of households. Higher water prices will not only encourage all users to use water more efficiently, but will also generate funds to maintain the existing water infrastructure and to build new infrastructure. The State Governments will have to show political courage to do so, before the water completely runs out, and people become totally dependent upon packaged waters, which is available at around ₹ 15/- per litre bottle.

1.4. Planning and Execution of Modern Water Supply Schemes

In planning a water supply scheme, it is essential, to first of all, search a source of water in the vicinity of the town or the city for which the scheme is to be designed. Sometimes, the water may be available nearby, and sometimes it may be far away. Further it may be an underground well, or it may be a river, stream or a lake. It is, therefore, necessary to seek out all the possible sources and evaluate each in terms of quantity, quality and cost, and then to take a final decision regarding the utilisation of a particular source or sources depending upon the availability of water in those sources and the water demand of the town or the city.

Suitable systems should then be designed for *collecting, transporting, and treating* this water. The treated water is finally distributed to the residents and industries depending upon their requirements, through a network of *distribution system*. The essential elements of a public water supply scheme may, therefore, consist of *Intakes and reservoirs* ; *a water treatment plant* having screening, sedimentation, filtration, disinfection units, etc. ; *elevated tanks and stand pipes* which provide storage to meet peak demands occurring for limited periods ; *valves* which control the flow of water in the pipe system ; *hydrants* which provide a connection with the water in the mains for fighting fires, flushing streets, etc. ; *mains, sub-mains and branch lines* which carry the water to the streets ; *services* which carry the water to the individual homes, etc. etc. All these essentials and components of a water supply scheme are described in details in the subsequent chapters of this volume.

PROBLEMS

1. (a) What is the importance of public water supply schemes in the present day civil life ?
(b) Draw the flow diagram of a typical water supply scheme using an impounded reservoir as the source of supply and show therein the different works involved.
[Note : Pl. see Fig. 2.2]
2. Describe the necessity of having a planned water supply scheme for a town. How are such schemes financed, planned and executed ? Discuss with special reference to the circumstances prevailing in India.
3. Why is it necessary to control the water quality in nature and also in community ?
4. Write briefly the historical background of water treatment and water supply engineering.
5. Explain the connection between 'Public Health' and 'Engineering', and also between 'Water Supply' and 'Diseases'.
6. "There is no shortage of water in India, yet the water supplies are very poorly developed here." Discuss critically the above statement, and suggest methods for improvements.
7. Explain what is meant by 'Healthy Environment' and how is it achieved in practice ?