A PARADIGM SHIFT IN CONCEPT OF WATER USE EFFICIENCY: KEY TO INTRODUCE CORRECTIONS IN WATER SECTOR OF INDIA

Vivek P. Kapadia
Chief Engineer, Narmada, Water Resources, Water Supply and Kalpasar Department, Government of Gujarat, Block No – 9, New Sachivalaya, Gandhinagar – 382010
Email: vivekpkapadia@gmail.com

ABSTRACT

India is considered as a water stressed country since water availability in many states have been below the threshold value i.e. 1000 m^3 per capita per annum. With time the stress would escalate has been the prediction based on rate of population increase and changing water use pattern. Increase in Water Use Efficiency has been much advocated in this light for industrial, domestic and agricultural sectors. As agriculture consumes more than 70% water, maximum efforts are made to increase the water use efficiency in agricultural sector. Discussions keep going on about the anarchy in the water sector but the grass root level corrections are somehow missing. The present notion of water use efficiency in agriculture is the yield produced per unit water. It is the same for industrial sector as well. This concept discounts some crucial aspects and hence some misleading thoughts are prevailing in the society. The most important is the net effluent produced and released which is not the case with the agricultural sector. Therefore, barring the percolation of irrigation water which contains some chemical fertilizers, there is no liquid effluent produced. The effect of the said percolation is not that significant in many parts of India. On the other hand, domestic and industrial sector which uses only 26% of water resources, leave highly polluting effluent which is released untreated or semi-treated in most of the cases which finally make manifold quantity of fresh water unusable. As effluent produced and released is not a part of water use efficiency in the present concept, a general impression created is that water use efficiency is the lowest in the agricultural sector. Actually, the present concept of water use efficiency limits its scope to the limits of the process of production to be sold in the market and consumption of water involved rather than encompassing the actual quantity of water affected in the entire process. Water Use Efficiency, in case, is allowed to be considered holistically like this, the real picture would emerge and corrective measures would be in the right direction. The paper discusses a paradigm shift needed in the concept of water use efficiency with the facts and data and underlines the need of treating the waste water properly so as to ensure the available water resources to be pure and usable. Corrections can happen only after acknowledgement of the problem and India needs to do so in order to place the water sector in right shape is the conclusion.

SHORTAGE OF FRESH WATER

Against estimated annual precipitation of about 4,000 Billion Cubic Meters (BCM) including snow fall, India's total annual renewable fresh water resources are estimated at 1953 BCM. Table-1 shows per capita water availability in India which suggests water stressed situation. Every year it is declining is also a matter of concern.

Table 1. Per Capita Water Availability in India

Year	Cubic meter Per Year
1901	4555
1951	3008
1971	1981
1991	1283
2025	943
2050	686

Table-2 shows basin wise water distribution which clearly indicates that the natural distribution of surface water is lopsided and hence in some regions flood and in some the draught. Lopsided natural distribution of water is another issue in addition to the low average availability and it is not that easy considering the vast geographical area of India with large topographical variations. In spite of exploring most of the sites for the dams neither the issue of floods and draughts has been possible to be addressed, nor can anyone claim that by constructing few more dams on the remaining feasible sites could be expected some effective solution. Therefore, water stress is not going to be addressed simply by creating more storages is very clear. With the increase in population and changing life style and changing water use pattern, the stress would escalate is also no denying a fact.

Table 2. Basin wise Water Distribution

Sl. No.	Name of the River Basin	Average annual availability in Cubic Km per Year
1.	Indus (up to Border)	73.31
2.	a) Ganga	525.02
	b) Brahmaputra, Barak & Others	585.60
3.	Godavari	110.54
4.	Krishna	78.12
5.	Cauvery	21.36
6.	Pennar	6.32
7.	East Flowing Rivers Between Mahanadi & Pennar	22.52
8.	East Flowing Rivers Between Pennar and Kanyakumari	16.46
9.	Mahanadi	66.88
10.	Brahmani & Baitarni	28.48
11.	Subernarekha	12.37
12.	Sabarmati	3.81
13.	Mahi	11.02
14.	West Flowing Rivers of Kutch, Sabarmati including Luni	15.10
15.	Narmada	45.64
16.	Tapi	14.88
17.	West Flowing Rivers from Tapi to Tadri	87.41
18.	West Flowing Rivers from Tadri to Kanyakumari	113.53
19.	Area of Inland drainage in Rajasthan desert	NEG.
20.	Minor River Basins Draining in to Different Rivers	31.00
Total		1869.35

Table 3. Land Use Details of India (Million Hectare)

Geographical Area	328.73
Forest	67.8
Not available for cultivation	41.56
Other uncultivated land	28.36
Fallow Land	24.10
Net area sown	142.02

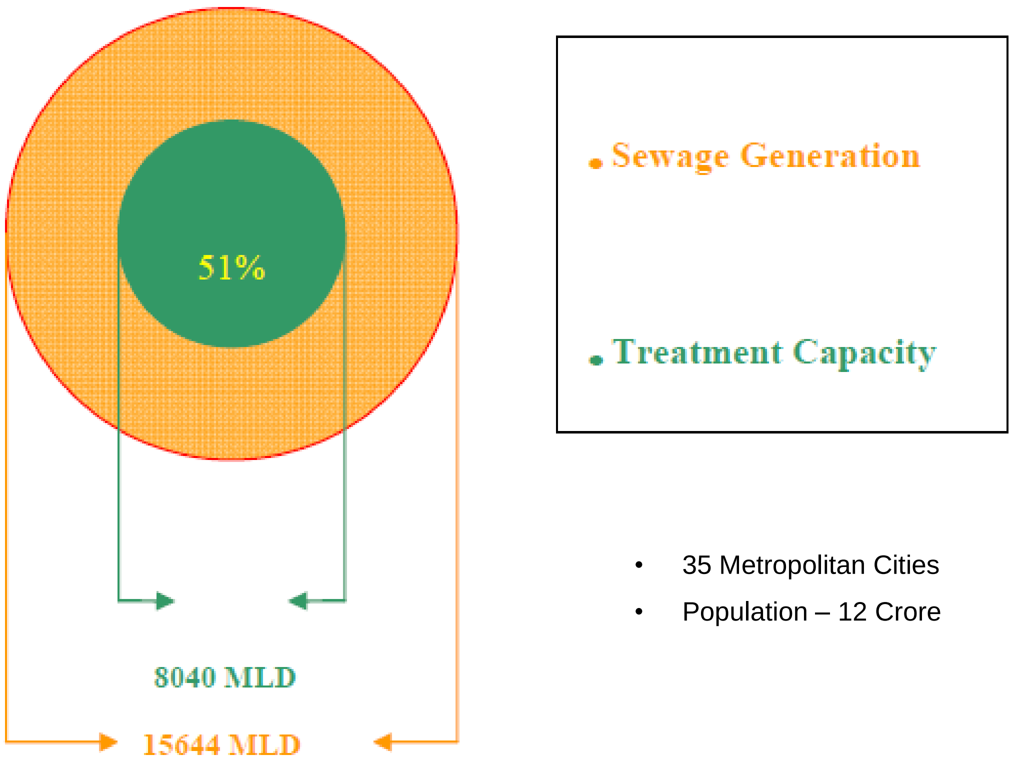
Table-3 shows the land use details of India which suggests clearly that out of 328.83 Mha (Million Hectare) land, actual available land for cultivation is over 200 Mha but the net area sown is only 142.02 Mha. Actual irrigation potential created is little more than 100 Mha till date and actually utilized is much less. It is important that irrigation potential covers all types of irrigation and hence it also includes the lift irrigation schemes and minor irrigation schemes. Thus, rainfed agriculture and non-utilized agriculturable land if considered, so far not even 50 % of the agriculturable land has availed water resources for agriculture in spite of constant implementation of the modern methods of irrigation. The same way, more than 50% of the population do not get sufficient and safe water for drinking and sanitation. Thus, the problem in total is for all the three sectors – agricultural, domestic and industrial because of scanty availability and lopsided natural distribution.

SOLUTIONS OF WATER SHORTAGE BEING TRIED OUT

It is a fact that besides water availability, management is a big issue and hence distribution is unjust. Still the shortage can not be denied. Therefore, in order to address the management and shortage – both, the concept of water use efficiency is tried hard to be implemented. Under the same concept, multidimensional efforts are being made like lining of irrigation canals, repair of dams, implementation of micro-irrigation, modification of seed varieties, enhancement of production technologies, advancement in machineries, enhancement of machine efficiencies, improvement in quality of fuels, etc. Sincerity in the said solutions is beyond doubt for those who are plunging themselves into, and, therefore, in spite of so much anarchy in the country, something like system still prevails. Per capita food production has been maintained amongst all the challenges is because of all such dedicated efforts. However, the efforts are falling short as compared to the size of the problems.

UNTREATED DOMESTIC EFFLUENT : BIG SOURCE OF POLLUTION OF FRESH WATER

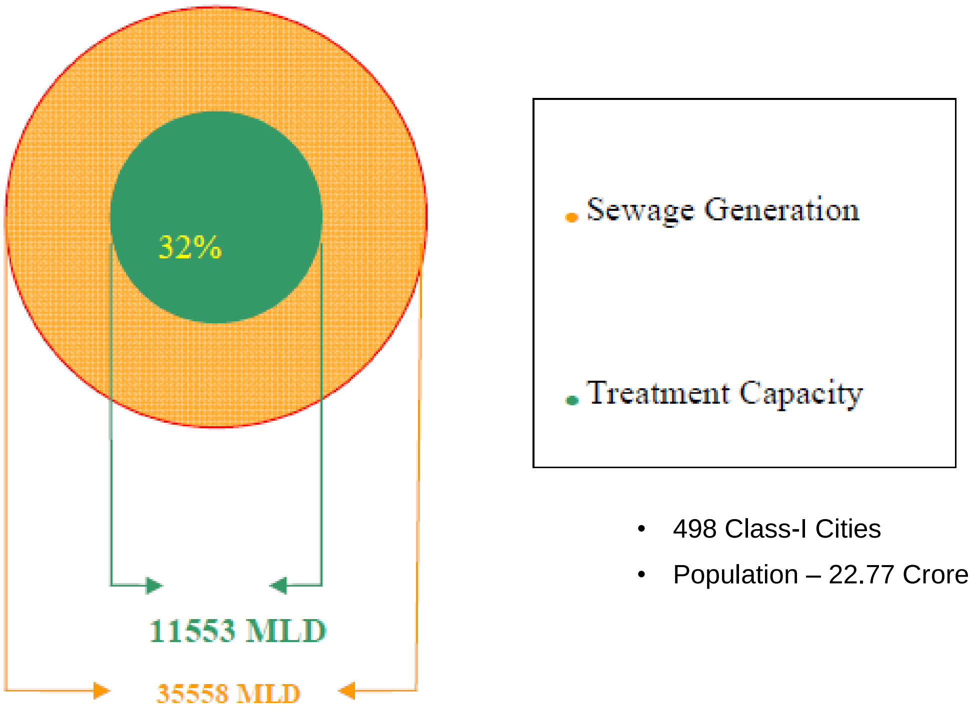
Domestic effluent is a big source of pollution in surface water i.e. rivers and water bodies. Concentration of pollution may be less than that in case of industrial effluent but the quantity of effluent is enormous and hence studying the situation of domestic effluent as per year 2005-06 is very interesting.



- 35 Metropolitan Cities
- Population – 12 Crore

Figure 1. Sewage Generation and Treatment Capacity in Metropolitan Cities

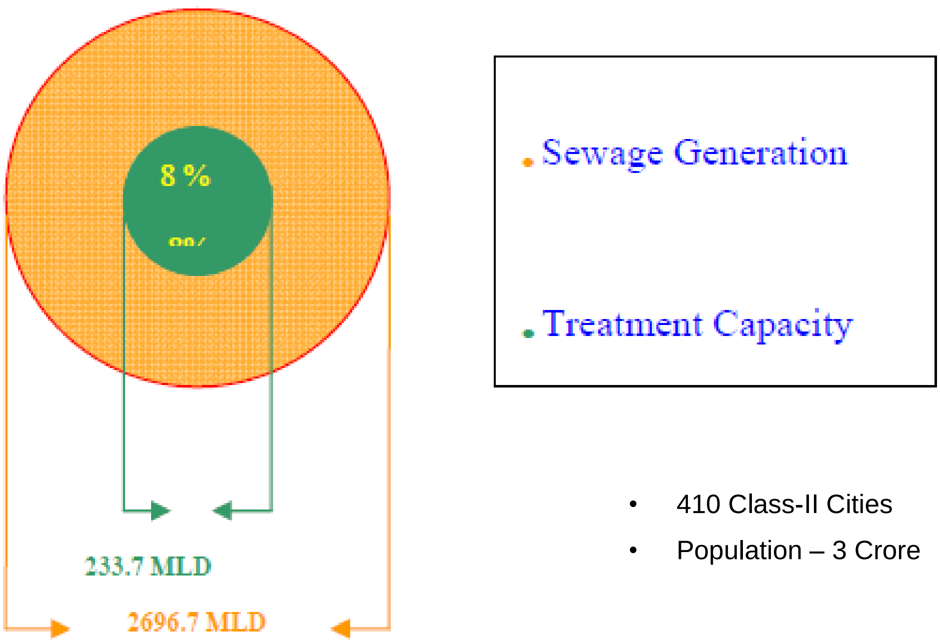
Figure-1 suggests that 15,644 Million Liters per Day (MLD) sewage is generated from 35 metropolitan cities (more than 10 Lac Population). The sewage treatment capacity exists for 8040 MLD i.e. 51% treatment capacity. Among the Metropolitan cities, Delhi has the highest capacity of sewage treatment (2330 MLD) (29% of the total treatment capacity of metropolitan cities). Mumbai has the second highest capacity (2130 MLD), which is 26% of total capacity in metropolitan cities. Delhi and Mumbai therefore in combination have 55% of treatment capacity of the metropolitan cities. Delhi, Mumbai and Pune have created sewage treatment capacity to treat more than 50% sewage generation. In rest of the metropolitan cities sewage treatment capacity is less than 50% of sewage generation.



- 498 Class-I Cities
- Population – 22.77 Crore

Figure 2. Sewage Generation and Treatment Capacity in Class-I Cities

As shown in Figure-2, there are 498 Class-I Cities (including Metropolitan cities)having population more than 1 Lac as per 2001 census. Share of Class I Cities is 93 % of total urban sewage generation in the country. Nearly 52% cities (260 out of 498) are located in five States viz. Andhra Pradesh, Maharashtra, Tamilnadu, Uttar Pradesh and West Bengal. Sewage generated in class-I cities is estimated as 35558.12 MLD. Total Sewage treatment capacity of class-I cities is 11553.68 MLD, which is 32% of the sewage generation. Out of 11553.68 MLD sewage treatment capacity in Class I Cities, 8040 MLD exists in 35 Metropolitan cities i.e. 69%. The capacity of sewage treatment in remaining 463 Class-I cities is only 31%.



- 410 Class-II Cities
- Population – 3 Crore

Figure 3. Sewage Generation and Treatment Capacity in Class-II Cities

As shown in Figure-3, there are 225 class-II towns (50% of total number) existing in five States viz. Andhra Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and Gujarat. Total sewage generation in class-II towns is 2696.70 MLD. Total sewage treatment capacity in Class-II towns is 233.7 MLD which is 8% of the total sewage generation.

Table-4 shows state-wise gap between the installed capacity of treatment and actually utilized capacity. This further reduces the treated quantity of domestic effluent.

Table 4. State wise STPs and Their Utilization

Sl. No.	State	Installed Capacity (MLD)	Actual Utilized capacity (MLD)	No. of STPs
1.	Andhra Pradesh	729.5	547.12	10
2.	Bihar	158	100	5
3.	Delhi	20	20	2
4.	Goa	12.5	12	1
5.	Gujrat	232	226	2
6.	Haryana	337	269.5	16
7.	Karnataka	42.8	26	9
8.	Kerala	4.5	0	1
9.	Madhya Pradesh	168.4	123.7	9
10.	Maharashtra	284	124.2	6
11.	Punjab	636.8	475.6	11
12.	Tamil Nadu	798.94	394	18
13.	Uttar Pradesh	779.6	585.8	24
14.	Uttrakhand	54	-	4
15.	West Bengal	458.29	222.5	34
Total		**4716.33**	**3126.42**	**152**

A significant volume of wastewater is not subjected to any treatment and is ultimately discharged into surface water bodies leading to deterioration of water quality. 26.5 billion liters of untreated wastewater discharged into water bodies. This is because there is a large gap between sewage generated and treatment capacity and also between the installed capacity for treatment and actually utilized capacity**.** Another issue is of poor maintenance of the treatment plants - discharge from 39% of STPs do not conform to environment protection standards. Because of al these factors, large quantity of untreated effluent is allowed to be discharged in the rivers and water bodies and hence the rivers of India are so much polluted. Table-5 gives details of basin-wise utilization of installed capacities of the STPS. If considered the effluent emerged and actually treated, the scenario would be worse. The reason for rivers being polluted is well understood from all this data. On more factor is very effective – industrial effluent and domestic effluent are not segregated in most of the cases in India.

Table 5. River wise STPs and Their Utilization

Discharge to River	Designed capacity (MLD)	Utilized Capacity (MLD)	%age of treatment
Ganga	587	322	55
Godavari	151	129	85
Hindon	164	138	84
Musi	541	480	89
Satluj	588	564	96
Yamuna river	754	562	75
Others	393	249	63

CONCEPTUAL FLAWS (INTERDIGITATED WITH WATER USE EFFICIENCY) AND CORRECTIONS

There has been a general argument that cost of treatment of effluent is unaffordable to the municipal corporations and municipalities. Actually the Cost of effluent treatment per MLD per month is approximately Rs. 30,000 whereas the approximate cost of urban roads per Kilometer is Rs. 5,00,00,000 and of maintenance is Rs. 25,00,000. The municipal corporations and municipalities have ample of budget for such expensive road networks but have meager budget for the treatment of effluent. This paradox can not be justified by any logical reasoning. It is only a question of political will. By not spending sufficient funds for treatment of effluent, precious fresh water resources are allowed to be polluted and at the delivery level, a huge expenditure is incurred for treatment of domestic water supply. Thus, instead of spending public funds at the source of pollution, they are spent at the delivery point though the quantity to be treated at source is much smaller than the one required at the delivery point. Even if the road infrastructure is spared from the apportionment of funds, no logic permits the present approach of heavily treating water at the delivery point to be justified. Cost on public health due to this illogical approach is if considered, need of the treatment at the source of pollution would be better appreciated. All these put in the frame of terminology, effluent is not produced beyond the scope of water use pattern i.e. after domestic usage ends, but during the domestic usage and therefore excluding it from the concept of water use efficiency is unjust. Another aspect should also be considered in this context – in any domain of engineering, efficiency means the relationship between output and input. For example, a machine or a winch or a pulley or a motor or a pump or a transformer – in any case, efficiency means the ratio between the output and the input. Then why in water use efficiency to consider input and consumption by excluding output is a mystery. When water use efficiency in domestic sector is talked of, it must include quantity and quality of effluent generated as it is a product of water usage. Instead of limiting the focus on repairs of the pipeline networks and redesigning the toilet tubs and flush tanks, how much fresh water resources are affected due to effluent would also become a matter of concern then which would make the concept of water use efficiency more meaningful and effective. Consuming more water and polluting almost nil versus consuming less water and polluting large quantum of fresh water would become comparable then, and, the misplaced priorities would also become apparent. It would make it clear that more than 70% water resources are though utilized by the agriculture, the real threat is by the sectors which use less than 30% of water. The stress on water is to be viewed in the right perspective which would help us appreciate that the quantity is stressed due to the agricultural sector and quality related stress is put by the domestic and industrial sectors. This would help identify the real issue and acknowledge the real cause of the problem. Corrections can be introduced with this fundamental point. When concepts or nuances are wrong, solutions are worse then the problems and exactly that has been happening with the water sector at present.

CONCLUSION

India is a water stressed country and in coming years the stress is going to be escalated. The water stress is not only because of availability constraints but also because of lopsided natural distribution. In the water stressed scenario, efficient water use is the only solution and for each water use pattern there should be techniques to enhance the efficiency. However, in India, it is found that the conventional concept of water use efficiency does not provide a holistic view as it focusses on the consumption of water for the particular water use patter but excludes the quantity and quality of effluent which pollutes the fresh surface water resources. This does not allow to identify the real problem and its cause and hence the corrections are not properly introduced or not envisaged as they should be. When water use efficiency in domestic sector is talked of, it must include quantity and quality of effluent generated as it is a product of water usage and that would make the concept of water use efficiency more meaningful and effective. The same should be for the industrial usage. Proper concepts and nuances are the prerequisites for proper corrections. Treating effluent at source is more advisable than treating at the delivery point.

REFERENCES

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