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Nagarlok, vol. 22, no. 2

202.6-6704

Some Issues in Management of Urban Water Supply Systems: A Case of Ahmedabad

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WHETHER SEEN in the general view that water is one of the fundamental needs for human existence, or analysed in a specific view that we are just three years short of our target year by which we aim to have "water for everyone", the issue of water supply continues to nag policy makers and researchers alike. Water supply is a typical multi-dimensional issue: The existing technical know-how calls for a lumpy investment (for the creation of the system) which is difficult to mobilize; it is also an extremely spatial issue, *i.e.*, water is to be supplied at the place where a settlement exists irrespective of whether water is available there or not; any regional policy or action necessitates intervention into natural processes and therefore technologically complex, costly and environmentally risky. In spite of all these, the need for water for every-one calls for "something to be done". It is no doubt that urban areas are better off in coverage of water supply. At the beginning of Seventh Plan, about 81 per cent of urban population was already covered by water supply whereas still about a half of the rural mass is yet to be covered by such system.[1] Moreover, in urban areas, the level of water supply in terms of quantity as well as quality will easily out do the water supply in rural areas. The riddle is that though, on the whole, urban water supply problem is small, each individual system involves consider-able size and complexity that from management perspective calls for more organized efforts.

With this background, our objective in this article is to examine and

*Acknowledgements are due to officials of Ahmedabad Municipal Corporation for their help.

[1] *The Seventh Five Year Plan*, Planning Commission, Government of India, New Delhi, 1985, pp. 301.

outline some issues in urban water supply management through a case study of Ahmedabad. A problem such as this, can easily be studied for years because there are myriad factors that are related to water supply; right from catchment basin characteristics and river hydrology to meteo-rology; and right from pipe length and diameter to investment, costs and pricing. We, however, restrict ourselves to examination of barely a few factors that have been perceived to have affected provison of water supply to average 'Amdavadi'. Just like other problems, water supply problem involves at least three perspectives in the scale of time. An elaborate examination of regional environmental issues is relevant in a long term perspective; at least a cursory examination of such factors is necessary in a medium term perspective. In a short term perspective which is more realistic, given the stringent financial situation of urban governments,[2] the factors to be considered are more local than global in nature. Our interest in focusing on a metropolitan city is again due to two reasons. On the whole, among urban bodies, the resource base of municipal corporations is better than those of municipalities. Even with such 'blessed' conditions large cities have still not been able to solve their water supply problem. Secondly, as Mills and Becker point out these big cities have a larger 'generic' city all around limits of the legal city and therefore the implications of short and long term plan-ning decisions are much more significant in such a context.[3]

ORGANIZED EFFORTS IN PAST FOR WATER SUPPLY IN AHMEDABAD

Ahmedabad has been the largest city in the state of Gujarat and prior to Jaipur's becoming a metropolis, it was the only city for the vast umland in western India. As the city began to grow into an industrial city, the form of city government and accordingly organized efforts for water supply underwent changes.

The first phase of these efforts dates back to the period between 1850 and 1891, during which some events like building up of barrage on *Sabarmati* for providing water supply to the city, etc., took place. However, a 'water supply system' was not born till 1891 when the water works on the eastern bank just north of walled city at Dudheshwar was built. The system consisted of four infiltration wells in the river bed, two steam engines and pumps and twenty-seven inches distribution main, with an initial capacity of 5.46 million litres per day (MLD) at the rate of thirty-six litres per person. The water reserve capacity was increased to

[2] Planning Commission, *Task Forces on Housing and Urban Development-II, Financing of Urban Development*, Government of India, New Delhi, 1983; para 1.19, pp. 4.

[3] Edwin S. Mills, and Charles M. Becker, *Studies in Indian Urban Development*, World Bank Research Publication, Oxford University Press, New York, 1986, pp.48.

29.5 MLD in 1912. In the year 1936 the steam engines were withdrawn and electric motors and pumps were installed in the water works. By 1950, as population was two and a-half lakh and even when the water supply was raised to about ninty-one MLD, the situation continued to be grim. To ease the position, Ahmedabad Municipal Corporation (AMC) undertook a major project for augmenting the water supply which was completed by 1954.

WATER CONSUMPTION AND SUPPLY SYSTEMS IN RECENT TIMES

Water consumption depends on several factors including the social and cultural factors and others like nature of industries, technology used, etc. As Burton and Lee point out, there are evidences to "show that the demand for residential water supply is a function of accessibility to water, housing conditions, the level of income and water using habits. Accessibility to water appears to be the most significant factor influencing the level of water consumption".[1] Along with increasing population and industrial activity, increasing accessibility, the water consumption in the city has been increasing. However, the natural factors, especially rainfall, seem to be having at least a minor effect on the consumption pattern. The details of water consumption in Ahmedabad are presented in Table 1.

A cursory examination of Table 1 reveals at least two observations:

(*i*) that there seems to be somes lagged relationship between the rainfall in current and previous years and water consumption rate in current year; and

(*ii*) that in recent years the efforts are to stabilize consumption at about 200 litres per capita per day (lpcd).

It can also be seen that up to about ninty per cent of total filtered water supplied is consumed for domestic use (which perhaps includes home based enterprises and other small establishments in informal sector). The policy of AMC is to concentrate mainly on supply for domestic purposes with the idea that indusiries can make their own arrangements. A brief digression is necessary here to examine the spatial dimensions of water supply in a bit detail. A land locked city like Ahmedabad has greater tendency to grow in a circular fashion. The core of the city is the walled city area housing several wholesale and retail commerical establishments. The city in AMC limits (with a total area of about 98 sq.

[1] Ian Burton, and T.R. Lee, "Water Supply and Economic Development: The Scale and Timing of Investment" in Leo Jakobson, and Ved Prakash, (ed.), *Metropolitan Growth: Public Policy for South and Southeast Asia*, Sage Publications, Halsted Press Division, John Wiley and Sons, New York, 1974, pp. 177-96.

TABLE 1 POPULATION, RAINFALL AND WATER SUPPLY IN AHMEDABAD FOR SELECT YEARS

Year	Population	Rainfall (in mm)	Average daily of filtered water ('000 Litres)				Per capita water supply in litres
			Domestic	Industrial	Others	Total	
1961	11,49,918	831.3	—	—	—	2,09,096	182
1971	15,86,544	544.7	3,32,250	156	4,395	3,36,801	212
1973	17,20,000	1070.9	2,87,837	1,270	5,993	2,95,100	172
1975	18,38,000	1238.0	2,76,750	2,600	13,150	2,92,500	159
1978	20,03,000	805.4	3,06,000	2,475	29,025	3,37,500	168
1981	20,59,725	955.7	4,03,485	3,317	35,654	4,14,590	201
1983	22,91,000	1085.7	4,37,800	3,618	38,900	4,52 320	197
1985	23,87,938	NA	4,53,318	3,633	39,056	4,59,140	192

SOURCE: *AMC Statistical Outline of Ahmedabad City*, 1984-85, AMC Ahmedabad.

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SOURCE: *AMC Statistical Outline of Ahmedabad City*, 1984-85, AMC Ahmedabad.

km) spreads all around this like a ripple. The eastern part of the city houses several textile industries and the low income population directly based on these industries (of total 83,800 hutments in city the more than 2/3 are in zone), whereas the western part houses more elitist development. Most of the statistics are readily available for this Ahmedabad. However outside the Municipal limits on eastern periphery, three large industrial estates with more than 5,000 industrial units and several other industries especially textile and chemical based ones, have been functioning attracting residential development. Development on the western periphery is more of institutional or residential nature. The municipal limits of AMC have been extended on east periphery to include an areas of about 95 sq. km. during February 1986. The larger metropolitan area of the city is of about 310 sq. km. covering the legal city (in AMC limits), the periphery of the city (falling in several gram panchayats and nagar panchayats), in the districts of Ahmedabad and Gandhinagar.

We can classify water supply systems in a generic sense into three types:

—organized public systems (OPS) where a public body manages the water supply and each individual household has only the function of consuming water without any investment.
—organized quasi, public systems (OQPS), where a quasi-public group like a cooperative society manages the water supply and households consume but also share the investment.
—Individualized System (IS) where a household directly invests (money or energy) in collecting the water from a natural source.

Most of the out growth areas in the peripheral city (where settlement pattern is somewhat sparsely distributed clusters) have either a small OPS if the local body could afford it or an OQPS by pumping the groundwater. Therefore there is lesser probability for all these clusters to be connected to the OPS of Ahmedabad city in immediate future. With this premise we restrict our further examination to the OPS as carried out by Ahmedabad Municipal Corporation.

SOURCES OF WATER SUPPLY

Human intervention for harnesssing water in the hydrological cycle is possible when precipitation (rainfall) turns into run off (surface flow) or after infiltration, (*i.e.*, ground water).

Sabarmati river is the main source of surface water for the city. The dry weather flow of Sabarmati is generally below three cumecs (100 cusecs) and during lean years, it was noted to be as low as about 0.6 cumecs (20 cusecs). In recent years, Sabarmati has been emaciating and

even a casual observer finds that river bed is functioning as an 'open space' to accommodate activities like circus and Gujari—the Sunday market. The river contributes about 36 to 46 MLD through the radial collector well located near Dudheshwar.

The city gets a part of its ground water from the river bed and rest from other locations. There are about 45 tubewell stations with 252 tube wells spread all over the city yielding about 300 MLD. There are 29 isolated bore wells yielding about 32 MLD. The infiltration wells in the river bed near Dueheshwar can contribute about 45 MLD in lean period and about 90 MLD in a flooding season. There are also borewells at Dudheshwar which are used mainly to pump water as and when required. The summary of water supply sources is presented in Table 2.

TABLE 2 SUMMARY OF PRESENT WATER SUPPLY BY SOURCE

Detail of Source	*Location*	*Number of Units*	*Quantum of supply in MLD*
1. Radial Collector well	Dudheshwar	1	36.3 to 45.5
2. Tube wells	45 stations at different locations an in the city	252	300 to 310
3. Isolated borewells		29	32
4. Infiltration wells	Dudheshwar	27	45 to 91
5. Borewells	Dudheshwar	25	As per requirement
TOTAL			About 450

SOURCE: *Collected from Water Supply Department*, AMC.

It can be visualised that ground water has been the major source of water supply for the city.

WATER DISTRIBUTION SYSTEM OF AMC.

For the purpose of distribution of water, the area in AMC limits prior to annexation is divided into three zones:

(*i*) *Western Zone*: The entire area on the west of Sabarmati is supplied water from 13 tubewell stations and a few borewell stations;
(*ii*) *Central Zone*: The walled city area and the area near Dudheshwar water works falling in this zone are supplied water from Dudheshwar and a few tubewell stations in the zone; and
(*iii*) *Eastern Zone*: For the remaining area water is supplied from the tubewell stations in the zone.

Each tubewell station commands a certain area. However, the entire

distribution system is interconnected the supply areas for various tube-well stations and Dudheshwar water works are generally demarcated.

The distribution system is continually expanded as new developments call for water supply provisions. The details of pipe line and number of connections added and the situation thereof for select years is presented in Table 3.

It can be seen that on an average, about thirty to sixty km of pipe line is laid out in a year and about four to five thousand new connections are given.

People get access to water through any of the three possible ways:

—an unsubsidized domestic connection which conventional dwellings of middle and high income groups get where the individual can afford to pay.
—a subsidized domestic connection by which about eight hundred households in chawls and hutments get water connection at a nominal contribution of Rupees ten per household; and
—One of the 2,800 public stand posts.

About 18 per cent of the population obtains water through community water supply and public stand posts and the remaining 82 per cent of the population is served by connections. Most of these (up to 96%) are unmetered connections because the quality of water does not encourage use of meters.

The water supply is intermittent for domestic use. People get water for about three hours in the morning from six A.M. and for about an hour and a half in the evening from 5.30 P.M.

Table 3 also reveals that over the last two and a half decades, as the network gradually expanded from 560 km to 1,800 km, the coverage in terms of per capita length especially in recent years varied over a small range. Unfortunately, we do not have any standards to compare this but the TCPO study[5] does give a scope for such comparison, no matter crude. In that study, figures of population served per km. of mains is available from which by simple inversing we can get the per capita length. It is observed that Vadodara system with a population coverage of seventy two per cent has a per capita length of 4.46 m. and Rajkot system with almost same population coverage has a per capita length of 1.15 m. It seems worthwhile to develop a set of norms (or monographs) specifying the system efficiency or costs for different per capita lengths at different levels of population coverage, for given geographical conditions (like flat or rolling terrain, etc.). Here we content

[5]Town and Country Planning Organization, *Level and Cost of Selected Municipal Services: An Empirical Study*, TCPO, Ministry of Urban Development, New Delhi, 1987, pp. 41.

TABLE 3 WATER PIPELINE LENGTH AND CONNECTIONS FOR SELECT YEARS

Year	Population	Length of Water Pipe line (km)		Length per Capita in metres (4/2)	Number of Water connections		Persons per connection (2/7)
		Laid in the year	At the end of the year		New in the year	At the end of the year	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1961	11,49,918	36.05	560.0	0.49	2,788	65,920	17.5
1971	15,86,544	—	1,115.13	0.70	—	1,07,137	14.8
1973	17,20,000	59.24	1,226.60	0.71	6,123	1,17,788	14.6
1975	18,38,000	34.98	1,292.18	0.70	3,885	1,23,315	14.9
1978	20,03,000	58.07	1,451.08	0.72	4,859	1,33,625	15.0
1981	20,59,725	60.96	1,671.05	0.81	6,765	1,54,120	13.4
1983	22,91,000	67.68	1,761.35	0.77	5,120	1,63,571	14.0
1985	23,87,938	20.38	1,818.04	0.76	4,431	1,73,348	10.8

SOURCE: Computed from statistics in AMC, Statistical Outline of Ahmedabad City, A.M.C. Ahmedabad.
NOTE: Population figures for census, *i.e.*, 1961, 1971 and 1981 are based on census and for other years on mid year estimates available in above source.

ourselves with the proposition that per capita length is a variable to be monitored with care if the designs should not become over-awed.

In recent times "water for everyone" seems to have been misunderstood to mean water connection for every house. However, in case of AMC over the years, it is seen that user density (persons per connection) is stabilized at about 13 to 14.

FORWARD PLANNING FOR WATER SUPPLY: EFFORTS OF AMC

The 'Virtual work' principle built into the intuitive capacity of human mind, affects the human decision to opt for easiest possible solution. Historically, surface source has been the obvious choice for water supply precisely for this reason and it is interesting to note that of the 145 class I cities today, 112 cities are located in one of the 14 major river basins in the country.[6] Though the river Sabarmati had its share in influencing the founders of Ahmedabad to favour this location, over the years, the dependence on Sabarmati is decreasing and ground water is increasingly withdrawn. As seen earlier, of the total 450 MLD of AMC's water supply for the city, about 340 MLD (*i.e.*, 75%) comes from ground water. Industries and textile mills also depend mainly on ground water and estimates put their withdrawal at about 90 to 110 MLD. In the absence of regular and adequate rainfall, this leads to lowering (or recession) of water table (at about 2.5 m. every year) resulting in several wells drying up. Increasing depth leads to increased cost of pumping and energy. There are also arguments that "...the river discharge... decreased significantly as the ground water drawal increased, even after good rainfall (and therefore) ... there is a close connection between the surface and ground water in this zone".[7]

The alarm call especially with the total drying up of Sabarmati in 1968, was well received and AMC decides to assess and work out a plan for water supply requirements in the city for coming decades. The result is AMC's participation along with state government in Dharoi Dam reservior project on Sabarmati at Dharoi nearly 150 kms. upstream of Ahmedabad. The project assured AMC of 680 MLD with 100 per cent reliability. The work of preparation of project report for ancillary

[6]Nilay, Chaudhuri, "Water Quality Management in India: Problems, Approach and Areas of Investigation" Paper in B.B. Sundaresan (ed.), *Proceedings: Workshop on Research and Development Needs for Water Supply and Sanitation Decade 1981-1991*, National Environmental Engineering Research Institute, Nagpur, 1980, pp. 30.

[7]A.H. Patel, P. Sharma, K.R. Ramanathan, "Integrated Approach to the Management of Water Supply for the City of Ahmedabad and its Metropolitan Area", Paper in *Symposium on Current Trends in Arid Zone Hydrology*, Physical Research Laboratory, Ahmedabad, 1978.

works to pick up, treat and distribute water that will become available from Dharoi project was entrusted to consultants and they submitted the report by 1973.

The population of the city was projected to be 27.2 lakh in 1991; 30.00 lakh by 1995 and 34.00 lakh by 2,001. The per capita consumption was projected to increase gradually from 191 LPCD in 1991 to 195 LPCD in 1995 and to 209 LPCD by 2001. The total water demand for domestic as well as other purposes and leakages. The details of this projection are shown in Table 4.

TABLE 4 WATER DEMAND IN AHMEDABAD BY PURPOSE (IN MLD)

Purpose Year	*1971*	*1981*	*1991*	*2001*
1. Domestic	223.0	376.6	527.8	716.7
2. Commercial and Industrial	23.4	44.3	61.7	80.5
3. Public	22.4	52.7	80.2	120.0
Total of 1,2,3	268 8	473.6	669.7	917.2
4. Leakages	26.9	94.7	100.5	137.6
	(10%)	(20%)	(15%)	(15%)
TOTAL DEMAND	295.7	568.3	770.2	1054.8
ROUNDED UP	296	568	770	1055

SOURCE: *Water Supply Department*, AMC.

Based on these projections, the demand for the year 1995 works out to 887 MLD and the plan was to meet this demand in a 'conjunctive' manner. The quantum of water to be drawn by source is:

(*i*)	Surface source (Dharoi Reservoir)+drawal from the 4 radial collector wells	682 MLD
(*ii*)	Infiltration wells in river bed	48 MLD
(*iii*)	Tube wells	159 MLD
	TOTAL	889 MLD

This implies an emphasised dependence on surface source and bringing down the ground water drawal to about half the present drawal of (more than 340 MLD). To pick up the water from Dharoi reservoir it was proposed to construct a water works and treatment plant at Kotarpur in the northern part of the city. Ahmedabad has been divided into 26 water supply zones and after required treatment, the water will be pumped to zonal underground reservoirs. It will be again pumped to overhead floating reservoirs from which water will flow by gravity to the users,

The financial estimates in 1973 put the total project cost at Rs. 31 crore which was surely a capital requirement beyond AMC's means and therefore some arrangements for raising the resources became necessary. AMC was able to tie up a proposal for the resourees with the State and Central Government, and LIC only in 1978. But by that time the price rise in cost of material, labour as well as land was such that the 1973 estimates which considered only two years escalation, became outdated. Till June 1986, the expenditure against the project works was Rs. 33.85 crore of which AMC had to spend as much as Rs. 16.5 crore from its own resources as seen in Table 5.

TABLE 5 TIE-UP OF FINANCIAL RESOURCES: PLANNED, ACTUAL AND PROPOSED

Source	*Contribution in Rs. Crore*		
	As planned in 1978	*Actual till June 1986*	*Current Proposal by AMC*
1. State of Central Government	12.00	9.84	36.94
2. LIC	9.00	7.50	27.70
3. AMC	10.00	16.51	30.78
TOTAL	31.00	33.85	95.42

SOURCE: *Ahmedabad Municipal Corporation.*

Having foreseen the situation, AMC prepared a revised cost estimate in 1984 and at the prevailing prices put the total cost at Rs. 72.34 crore and put up for approval of Planning Commission and the then Ministry of Works and Housing. This was cleared by September 1985 with target year as 1988-89. But till the end of 1986, financial arrangements were not finalised and works had to stand still. The revised estimate as at the end of 1986 puts the total project cost at Rs. 95.42 crore. AMC requested that financing should be in the same pattern as decided earlier, *i.e.*, about 39 per cent to be borne by State and Central governments, 39 per cent by LIC and the remaining to be borne by AMC. If all the connections have to be metered it may again require about Rs. ten crore. The corroded GI pipes which connect the individual household to the service main have been found to be the major cause for leakage as well as entry of foul water into the supply system and replacing them requires another Rs. ten crore. For providing adequate water supply to the recently annexed East Ahmedabad, funds up to the tune of 80 to 100 crore may be required. The list perhaps can continue and the day when Ahmedabad can look back proudly to say that there is"... *water for everyone*" seems to be far.

CONCLUSIONS AND IMPLICATIONS

It is appreciated that a local body like AMC could plan and get into the implementation of a project of this nature. However, two critical factors, if ignored, can seriously jeopardize the efficacy of such project. These are, an appropriate design and well worked out implementation.

Implication for Appropriate Design Standards and Decisions

It can be seen from discussions above that meeting the requirements of any urban service like water supply, sewerage or transportation calls for efforts and resources which are generally beyond the scope of a local body. However, it may be too drastic to jump into a conclusion that urban local bodies cannot tackle such an issue. In spite of all the criticisms, local bodies alone allow for a more effective feedback from the concerned citizens and therefore a built-in extravagance-control mechanism is possible. Though we believe in such possibilities, what we don't believe is that level of investment can be brought down with an arbitrary decision making system.

Expressed in a crude manner, the design of an urban water supply system involves three steps:

—an understanding and judgement regarding the expected output based on standards and needs;
—an understanding of the limitations imposed by the natural environment; and
—an appropriate design of various sub-systems and elements.

It is interesting to observe that there exist independent and fully developed fields of science devoted to the second step in terms of hydrological analysis, flood routing, etc., and to the third step in terms of design of network systems and water supply engineering. However, the entire rationality and objective analysis in these two steps base themselves on the decisions pertaining to the first step. The decisions of how much minimum quantity of water is sufficient, what kind of distribution system should we have, etc. are some of the issues totally based either on standards or value based judgements. The standard recommended by the Expert Committee for Manual on Water Supply and treatment for communities with population above 50,000, is a supply of 125 to 200 LPCD.[8] But the actually adopted figures vary on a much wider range of about 52 LPCD in Jallundhur[9] to about 240 LPCD in Delhi, with

[8]The expert Committee, *Manual on Water Supply and Treatment*, (Second edition), Central Public Health and Environmental Engineering Organization, Ministry of Works and Housing, New Delhi, 1984, pp. 6.

[9]Town and Country Planning Organisation, *op. cit.*, pp. 45.

others like Madras (73 LPCD) and Bombay (139 LPCD) in between.[10] The other aspect of standard pertains to the mode and nature of distribution system. Should we stop with a community stand post or should we have house to house connection? The trend seems to be following the western standards of house to house connections without assessing whether that is affordable to us as a society. It is basically the loose-footed standards which make the water supply programmes to become grandiose plans involving huge amounts of investment. This lumpiness of investment is precisely the beginning of the "lack-of-funds" viscious circle. To break the circle it is necessary to begin with realistic standards. Higher the quantity of water supplied in terms of LPCD, higher is the cost of water and also higher is the cost of treating the waste water that is generated. On the other hand, higher the quantum of water supplied, lower are the costs of inconvenience to individuals. Similarly, house to house connections avoid the cost of transporting water from standposts to home, as well as cost of possible contamination on the way but add to the investment requirements considerably. We feel that there is scope for further research, in these areas, to evolve a framework for objective decision making. The designs evolved on the basis of these decisions should be tested for the length of network per capita, to avoid over designing or undercoverage which can be wasteful.

Delays in Implementation

Projects of the nature discussed here, in spite of all their excellent design become out dated because of delays in implementation. It appears that delays can crop in due to various reasons some of which are:

(*i*) *Delays Due to Lack of Finance*: As specified, the possibility for meeting the capital requirements of water projects entirely from urban government's funds alone, is rather bleak. Therefore all such projects should be phased down explicitly into components such that up to about 60 per cent of the financing of each component can be met by the urban government. Such phasing may take longer time than otherwise to complete the project but can ensure that project does not come to a standstill. All effort to form a specialised financing agency like the proposed Urban Infrastructure Finance Corporation, seems to be positive signal in this arena. What needs to be researched further is how to reduce the time taken to appraise and process the details of a project before releasing the loan amount. An appropriate information system seems necessary.

[10]Delhi Water Supply and Sewage Disposal Undertaking, *Budget Estimates 1986-87 and Revised Estimates 1985-86*, DWS and SDU, New Delhi, 1986, pp. 1.

(*ii*) *Delays Due to Involvement of Diverse Agents*: This is basically a problem of lack of coordination and agreement and extraordinary dependence on procedures. Therefore we have to rethink on procedural issues as well as means for establishing a forum such that officials in the senior management cadre from all the concerned agencies can come together. If we can informalize industrial development or export service under one window, we can also informalize (with little change in legal doctrines) the inter-agency communication flows.

(*iii*) *Delays Due to Legal Issues*: Issues like land acquisition can seriously undermine the plans and proposals and such delays can hamper the basic objectives of the project itself. While designing huge urban infrastructure projects, it may be worthwhile to link the process of detailed designing to land acquisition. Before the finalisation of the design some advance understanding can be established with landlords (and to that extent transfers can be stopped) and then go in for detailed designs of plants, etc., after incorporating any possible changes.

A rethinking and further research on these issues can expedite the formulation and implementation of urban water projects and can avoid unnecessary investments, wastage, locking up of voluminous resources getting locked up in half-built infrastructure systems. □