INTRODUCTION

Water supply, drainage and sewerage, two of the most important pillars of sanitation, which usually go hand in hand, exercise a marked effect upon the health of the general community. The social progress of any community can be gauged on the basis of the provision of these services by the municipal Government. Water is required for domestic, sanitary and commercial uses. Melosi calls these services the 'circulatory system' of the city.¹ A study of the growth of these systems is important, as it displays an array of national and local, socio economic, political and administrative policies, relating to urban growth, as also prevailing health and ecological theories and practices.

The phenomenal growth of these two sanitary services can be traced to the industrial revolution of the nineteenth century. Rapid industrialization, in this period, created wretched working conditions for the poor working classes, who stayed in crowded localities without sewers or drains and a poor water supply. Such conditions engendered diseases. At this time, the publication of Edwin Chadwick's famous report on the sanitary conditions of the labouring population of Great Britain, in 1842, laid the foundation of the idea that prevention of environmental deterioration was cheaper and more effective than expenditure on the relief of the poor. Convinced, that the preservation of a nation's health was as important as the promotion of its commerce or maintenance of its conquests", ² Chadwick insisted that "Every efficient measure of improvement of the sanitary condition of the population must be in its mere pecuniary results a measure of a large economy" ³

Therefore, the ‘economy’ of sinking money, in works of sanitation such as improved drainage and water supply began to be realized.  

It is in this period, that one can trace the emergence of the modern ‘bacteriological city’. The latter came to be identified with new methods of sanitation, based on the hydraulic system of water supply and underground drainage, which required intensive use of technology and heavy expenditure periodically. With reference to this development Briggs says, that the hidden network of pipes and drains was perhaps one of the biggest technical and social achievements of the Victorian age and the sanitary system was considered more comprehensive than the transport system.

Since such sanitary works fell in the category of “everybody’s business and nobody’s business” need was felt to regulate them. This paved the way for their regulation.

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takeover by the State. Therefore, from this period one also sees the beginnings of legislative enactments, by the State, in the field of sanitation, and the advance of an organized system of municipal establishments. Over a period of time, the State gained complete control over the individual life, thus dictating the manner in which the water was to be brought into houses, how buildings were to be constructed and where and how sewage was to be deposited. Consequently, public health also came under the ambit of the State. It created an environment, which persists even today, that provision of water supply and waste water treatment is the business of the State.

Sanitary legislation was preceded by the collection of statistical evidence, an increase in the staff of the central health department and the gradual development of a “scientific basis for the progress of sanitary law and administration” However, it needs to be noted, that the sanitary legislation that emerged in England, at this time (1860-70), was complex and experimental in nature. Sanitary law was largely unknown, or at best difficult to understand. Not only this, the nascent sanitary movement of Victorian England, which had gained momentum only in the 1840s, was equally experimental in nature, and riddled with corruption. It was noted by a contemporary author that the sanitary notions and knowledge of sanitary works, was vague in England at this time (1838-56). Furthermore, Edwin Chadwick, who had created a public opinion, in favour of sanitary reform, and pursued the subject of drainage and water supply, was himself, accused of falsehood and suppression of truth, of ‘use of false measures and unjust balances’ and corrupt attempts to increase expenditure and other charges of a similar character. later, and his technical innovations having been found to be ill conceived. he was removed by 1850.

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9 BG Bannington. English Public Health Administration. PS King And Son Ltd. Westminster. 1915. pp 8-9
10 Engineers and Officials, op. cit. p 218
11 Ibid. p 37
12 Ibid. p 228
Talking about the same period therefore, historians like Briggs assert that the sanitary movement was marked by alarming signs of confusion and waste before there were signs of control. Lewis Mumford refers to these sanitary developments as the negative gains of the nineteenth century city, which aimed at achieving a "minimum standard" in ever thing, while Daniel Headrick looks at them along with others, from the point of technology transfer.

In India, this technology transfer took place under the British rule at a time when people across the country, depended for their water supply, on the existing tanks which had been developed since ancient times. Due to the seasonal nature of its rains, Indians had built up numerous types of water harvesting systems to meet their need, round the year, making them possibly the world’s largest water harvesters. But instead of damming rivers, they caught enormous amounts of rainwater, which fell in their own village, before it disappeared into the river. Tanks and wells were therefore, seen as decisive elements in good water management both in urban and rural areas. These locally developed technologies were further supported by an elaborate system of property rights and religious practices and the tanks themselves, along with their catchments, acquired religious importance which preserved them from pollution.

But after 1857, when the country came under the direct rule of the British Crown, there was a rapid decline of all the major social and economic institutions in India, including those relating to agriculture and water management. During this period, as

14 Briggs, op. cit, p 24.
Arnold asserts, science, technology and medicine, was used by the British as a ‘civilizing mission’, in India and also to emphasize their own superiority over, and imperial responsibility for, a land they identified as superstitious and backward.\(^{18}\) The same was also used to ‘improve’ and ultimately to ‘modernize’, India.\(^{19}\)

Naturally, therefore, even water management in Bombay city came to be profoundly influenced by these developments, leading to the introduction of the new water technologies, referred to as the hydraulic or gravitational schemes, based on the creation of artificial reservoirs by damming rivers or water streams in the hinterlands of the city. But such projects, as Hazareesingh pertinently observes, though often expressed in both a ‘modernizing’ and in a pro-poor discourse, merely served to increase the colonial State’s share of urban land and thus create new opportunities to amass revenue.\(^{20}\) Further, they centralized authority in the hands of the British. Over a period of time the new system completely overwhelmed the traditional systems.

The Vihar Water Works, functional by 1860, developed in Bombay city, as a popular symbol of sanitary and urban improvement and came to be consistently regarded as one of the ‘material boons’ of the western civilization.\(^{21}\) It is popularly believed, that the city is deeply indebted to the liberality of Lord Elphinstone, for the execution of these works, whereby “a population annually liable to decimation by water-famine ” was for the first time supplied with a sufficiency of good water.\(^{22}\)

Vihar set the trend for the growth of piped water supply in Bombay city, soon to be followed by the creation of the Tulsi, Powai and Tansa. All the same, the city’s

\(^{18}\) Arnold, Science and Technology, op. cit. p 15

\(^{19}\) Ibid. p 212


water supply, as also the drainage and sewerage problems continued unabated. This is evidenced by the contemporary newspaper reports. The Indian Express of 2\textsuperscript{nd} January 2014 noted that, of the 3.500 million litres of water supplied to the city, every day, nearly 700 million litres are being either lost to leakages or stolen. Contamination of water supply and low pressure continue to afflict the city. For that reason, the city has sought to implement the ambitious WIDP (Water Distribution Improvement Programme) for the equitable distribution and effective management of water in the city. It involves the use of even more sophisticated technology for leak detection, GIS mapping of the existing water supply network, reducing water contamination and a 24/7 customer helpline. Unfortunately, it has received only a lukewarm response from bidders.\textsuperscript{23} In the same way the notorious floods of 2005 are a standing proof of the city’s poor state of drainage and sewerage.

Therefore, right from its inception in 1860, to the present times, Bombay’s water supply has been the subject of much discussion, debate and anxiety as the city has recurred to increasingly distant sources, in order to satiate its demand for water. Volumes have been written on this issue from the administrative, engineering, planning and historical point of view.

Survey of Literature

Among the nineteenth century Marathi sources, which talk about the creation and evolution of the sanitary systems, mention must be made of two important books. Govind Narayan Madgaonkar’s, Mumbaiche Varnan, Varada Books (4\textsuperscript{th} Edition). Mumbai 2002, (First Edition 1863) and Balkrishna Bapu Acharya and Moro Vinayak Shingne’s, Mumbaicha Vrittant Prachin ani Arvachin Varananatmak Nakashansaha, published by Janardan Mahadev Gurjar. Mumbai 1889. (Reprint 1980), talk about the droughts faced by the city periodically, the wells and tanks on which the city was dependent for its water supply and the creation of Vihar. Shingne’s book further notes the creation of Tulsi. Both books look upon the new systems favourably.

\textsuperscript{23} The Indian Express. Mumbai News line. 2\textsuperscript{nd} January 2014. p 2. Currently Mumbai has 129 flooding spots: Ibid. Mumbai Newsline, 12\textsuperscript{th} July 2014, p 7.
Examination of this issue, in the recent times, has concentrated on a study of its political aspects and sanitary impacts during the nineteenth century. One of the most important studies in this area, that of Mariam Dossal, first published in 1991, has brought out an interesting and elaborate account of the inception and growth of the water supply and drainage systems, as a part of urban development until 1875. Based on a study of primary sources, she has examined the water scarcity issues leading to the development of Vihar and then Tulsi, in the wake of the conflicts between imperial policies and local needs. Her work throws a search light on areas such as the financial hurdles faced by the fledgling municipality of the city, the role of Henry Conybeare, the architect of Vihar, the Indian response to the new mode of supply and the development of drainage and sewerage of the city, in the backdrop of the city's notoriety as a cholera nest.

On the other hand, the equally interesting work by Mridula Ramanna, published in 2002, looks at the development of water supply and drainage and sewerage as a part of the measures to improve the public health of the city. Thus, both these facilities have been viewed as a part of the sanitary development of the city. In agreement with Dossal, even Ramanna, has highlighted the problem of water scarcity, and the issue of financial constraints, faced by the local Government in the implementation of these urban projects.

Varsha Shirgaonkar's publication of 2011 is an account of the origin and growth of the lakes, which supply water to Mumbai, up to the 1890s. Alongside, she has also given a detailed description of the Water Fountains in the city. Other works like


those by M.D David\textsuperscript{27} have briefly mentioned the inauguration of the new water chapter in the history of the city, while Mumbai’s Water\textsuperscript{28}, a publication of the Bombay Municipal Corporation, looks at the growth of the water supply system from an exclusively engineering point of view.

Such is the interest generated by the city, that it has prompted a number of historians such as Amar Farooqui\textsuperscript{29}, Rajnarayan Chandavarkar\textsuperscript{30} Sandip Hazareesingh and Prashant Kidambi\textsuperscript{31} to explore these urban developments in Bombay from the early nineteenth to the early twentieth century.

Implicit in all of the above narratives, however, is the assumption that water scarcity and the needs of the people led to the conception and execution of Vihar and that the


\textsuperscript{29} Amar Farooqui. Opium City The Making Of Early Victorian Bombay. Three Essays Collective, 2006


latter inaugurated an era of civic reforms. Similarly, like Dossal, most of them, while referring to the growth of the water supply, talk about its inadequacy and poor quality. They also point at the glaring defects in the city’s drainage system. However, they are limited in their approach. Even while accepting that unequal access, characterized these new supply systems and that they were used as tools of controlling the people, Dossal’s work, for example, only looks at the financial and the political factors as the stumbling blocks; a point echoed by Farooqui. Chandavarkar, on the other hand, points at the lack of a ‘social policy’ on the part of the Government, for the failure of these schemes to deliver the promised sanitary reform. Kidambi’s work shows greater leanings towards the functioning of the Bombay Improvement Trust.

Even while agreeing with the above arguments, I feel that none of these works explain, effectively, the nature of the water shortages experienced by the city and the way, the water that emanated from the hydraulic schemes, executed to address this scarcity, was managed in the city. Nor is it clear, as to why the city could never efficiently solve its water supply or drainage problems, despite technological intervention. Further, the above works do not look at the later developments in the area of water supply drainage and sewerage in the expanded framework of the city limits. This is so, since water supply management has been viewed only as a part of urban development and has not been the central point of research. These therefore, constitute some of the important gaps which I feel need to be addressed, in the present corpus of writings on the history of the water infrastructure of the city. Besides, water management needs to be studied in the context of a larger number of issues, than can be found in these writings.

Here, I feel a greater insight into the problem of the city’s water supply, is provided by Matthew Gandy who talks rather convincingly about the hydrological dystopias’, that is massive inequalities, to be seen in the city’s water supply system, which he relates to the ‘supply oriented engineering ethos’, that has dominated the water works, right from their inception. Going beyond this, he says about the water
management in the city that, the needs of the latter have always placed above the
needs of the region, thus escalating rural urban tensions. ³²

As someone who has had a firsthand experience of the immense problems of
intermittent water supply system, as a resident of Dombivali, (under the Kalyan
Dombivali Municipal Corporation) and later, having tasted the benefits of the
constant supply system at Borivali (under the Municipal Corporation of Greater
Bombay), I tend to agree with Gandy. Further, the feeling that the present sanitary
systems are ineffective has been strengthened after experiencing the disastrous flood
of 2005, in Mumbai. Technological intervention therefore, I feel, has not solved the
water management problems of Mumbai to the extent they should have, for a variety
of reasons which I have humbly attempted to study. ³³

It is also important to understand that water has emerged as a key element of control
in the economic and sanitary growth of all Indian cities today. The criticality of this
resource is obvious from the methods being used to ensure its supply, distribution
and conservation. A variety of technical and institutional options, ranging from
centralized surface storage to decentralized rain water harvesting systems are being
explored in order to aid this process. It is now openly acknowledged that if cities are
to continue on their path of development, it is important that this finite resource be

³² Gandy Modern City, op cit, pp 18-19; also read by the same author Rethinking
December 2004 and Landscapes of Disaster: Water, Modernity And Urban

³³ Although not directly connected with the area of research, the specialized
writings, on the history of environment, by Indians such as Madhav Gadgil and
Ramchandra Guha as also by American authors such as Lester Brown and Martin V
Melosi, have greatly influenced this work. Read Madhav Gadgil, Ecological
Journeys the Science and Politics of Conservation in India. Permanent Black,
Ecology and Wild life Series. 2001. Read also. Lester R Brown, Eco Economy,
Building an Economy for the Earth. Earth Policy Institute, USA. 2001
managed through a proper vision and effective planning.\textsuperscript{34} For this, one needs to look into the past history of water management in the city. Such an attempt, I feel will not only help in understanding the problems that afflict the system today but also assist in finding solutions to the latter.

The present work therefore looks at the water management policies from diverse historical perspectives. Water had numerous roles to play in the city. Apart from its use in domestic and public sanitation, it has been viewed as an agent of town planning and commercial expansion. Water supply arrangements have also had a critical role to play in the sustenance of the city’s fauna such as the cows and the buffaloes. The new water technology, inaugurated by Vihar, transformed everyday life, by providing water more conveniently, aided sanitation, stimulated commerce and thereby the city’s physical expansion. But, it was precisely these features, which, I feel, became the system’s weak points. As the city grew in space and numbers, complications increased. The latter were compounded with the emergence of coordinate administrative bodies such as the BPT, BIT and the BDD, which came up with their independent and inevitably conflicting agendas of development, where water was essentially required. Water thus emerged as a pawn in the hands of these bodies. Furthermore, it changed the native outlook towards water. From being a resource, which usually had to be worked for, and always had to be conserved, water became a continuous domestic facility.\textsuperscript{35} Thus, it gave rise to new challenges with which the city grapples even today.

The newness, and the complexity of the system, the maintenance of which required huge amounts of money, at regular intervals, made it the subject of control via different instruments which spawned much debates, discussions and contestations amongst administrators, planners as well as the Indians, leading to decisions which had significant ramifications for the city as well as the suburban and rural areas.

\textsuperscript{34} A K Jain, A Sustainable Vision For Urban India Kalpaz Publication. New Delhi-2008, p11

Similarly, the new water supply system led to momentous changes in the municipal structure. The other areas, which were to a great extent affected, were legalities of the supply system, housing and the spatial organization of the city itself.

The proposed research therefore looks into all the above issues by studying, the history of municipal water supply management, in the pre and post independence Bombay, from 1845 to 1957. The long span of time helps in a detailed study of the reasons for the establishment of these systems, the role played by engineers; the developments in technology; the attitude of the British rulers towards the creation of these systems; the urban growth of Bombay the traditional systems and the evolution of water management policies post Vihar.

Beginning with the manifestations of discontent, among the people of Bombay city, with water availability and the British response thereto, in 1845, it takes into account a 112 years of Bombay’s water history, right up to the completion of the Vaitarna cum Tansa scheme in 1957. The latter date also saw the merger of the suburban areas in the municipal limits of Bombay with considerable repercussions on the city’s water supply management. Also covered, are the various key decisions in the pre and post independence period in the area of sanitation, regulatory mechanisms, municipal growth and suburban expansion through the prism of water management. The time period of the study undertaken also helps recognize water management policies in three significant periods of the city’s history. These are, Bombay under the East India Company (1845-1857); the Imperial Crown (1857-1947); in Independent India (1947-1957)

Chapter one, unfolds the story of Vihar, in the light of the nature of scarcity faced by the city. The chapter also traces the growth of the hydraulic systems in the city up to 1957. Some of the important questions posed in this chapter are why and under what circumstances were the supply systems expanded and whether they fulfilled the aspirations of the masses? Were technological interventions always successful in solving the city’s water woes? Similarly, what was the nature of Indian response to this technology? At the same time what bearing did the new systems have on the local self governance of the city?
Chapter two looks at the twin of water supply that is the city’s waste water systems. This was a highly controversial area. Therefore, the chapter endeavours to explain the gradual change in perspective of drainage and sewerage over a century, while at the same time highlighting the inconsistencies in the Government policies with regard to this important pillar of sanitation, on account of the influence of the Bombay Port Trust, and the Army. Finally, it evaluates the success of the drainage and sewerage systems in modernizing the city of Bombay.

Chapter three explores the relationship between diseases and water supply. In this water management policies, have been dealt with from a sanitary perspective. A lot has been written on the role of the new water supply in combating diseases. However, diseases themselves had a great impact on the quantitative and the qualitative aspects of the traditional and the new water supply system. Three diseases viz. Cholera, Malaria and Plague have been considered in this chapter since they were threats to the imperial trading in the city. This chapter also extends investigation into the area of sanitary housing. The vital questions that have been posed here are; what place was water given in the planning of sanitary housing and whether it did solve the sanitary problems of the city?

Chapter four examines the role of water technology as an agent of Town Planning, which had caught the fancy of the British administrators by the beginning of the twentieth century. Suburban expansion was therefore inevitable. The latter was looked upon as a means of escape from the insanitation of the Island city. Suburban development was however hinged upon the two key aspects of water supply and drainage. This chapter therefore, throws light on the policy of water supply by the Bombay Municipal Corporation and the Development Department to the suburban regions; the politics of water supply and the inter as well as intra- regional conflicts, on the issue of water. It also draws attention to the core city’s association with its suburban neighbours.

Chapter five probes the uneasy relationship of the city with some of the difficult issues created by the new systems. Finance, the very basis of the new systems was always a source of problem. It tries to understand how the city tried to solve its financial problems through the agency of water. At the same time it explores the
complexities of water management in a city, which had multiple governing bodies. It also looks at the impacts of the new supply systems on the hinterland, where the lakes of the city are situated. Formation of dams, to create the new water supply systems, meant acquisition of lands here. The reaction of the people and the ultimate impact of these land acquisition policies, which became inextricably intertwined with the Forest management policies of the Government, are the areas of attention. In short, this chapter analyses, in detail, the long term socio-economic and cultural impacts of the hydraulic systems.

It is clear therefore, that water management is a multi faceted area of study, intimately connected with almost every aspect of the city’s socio political, economic and administrative life, its people and institutions. A study of this nature, naturally involves an understanding of all the above, as well as the scientific aspects of water supply. Therefore, for the purpose of such a research, a lot of rich and varied archival material has been used in the form of unpublished Letters, Memos, Government resolutions from the General Department, PWD, Military, Education, Revenue and Home Departments. I have also used Proceedings of the Bombay Legislative Council, the Institution of Engineers, Abstract Proceedings of the Sanitary Commissioner, as well as the Proceedings of the Standing Committee and Bombay Municipal Corporation. Contemporary Reports, newspaper articles and literature, apart from secondary literature, have also informed this research.

Graphs and maps have been used at appropriate places, in support of my arguments. Certain areas of discussion, such as municipal and legal development, however, are recurring in nature and have spilled over to all chapters. Yet, the work does not claim to be an exhaustive one. Such is the nature of the subject, that a lot more can be done especially in the areas of suburban development and impacts of the gravitational systems on the hinterlands. Any further study in this area also offers scope for tracing the development of water related environmental legislation in the twentieth century. Finally, it might be added here, that this work is not a diatribe against the hydraulic technology, per se, but simply attempts to understand its role in the water management of the city in a holistic manner.