

## **An Uncertain Future**

### ***The Unstable Supply of Urban and Rural Water for Mumbai, India***

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#### **Abstract**

Water is essential to the survival of the human race. In developed countries we may formulate the idea that water is inexhaustible. For example, you can go up to your nearest sink and fill yourself up a large cup of clean, fresh, water within seconds. This scenario is not true in many parts of the world. It is especially not true for Mumbai, India. Our project focuses on the unstable urban and rural supply of water for the Mumbai, India region. The water infrastructure in Mumbai is more than 100 years old and lacks adequate construction. Due to its age, it is crippled with bacterial infestations. The current population of Mumbai is 13 million with an expected 25% increase for 2021. The population will be 16 million in 2021 and water demand shortages are sure to develop. In many areas of Mumbai, especially rural/underprivileged areas, water shortages are currently the norm. These demand shortages are projected to intensify to new levels in 2021. The rural populations suffer the greatest because they do not have the financial support to obtain water. The water that is currently supplied in Mumbai is distributed unequally. The more wealthy residents have a constant supply, with the lower income brackets getting water only a few hours a day. These water supply and management problems are what we will address in our project. Our project goals are to: determine how the water is currently distributed in the Mumbai area, to evaluate the current problems and how they are expected to intensify in the future and to propose new infrastructure or policies that can be implemented to address these problems. We will propose projects that meet both the urban demand, as well as the rural demand in Mumbai, India. Obtaining adequate funding will be our biggest limitation, but we will try to develop low cost solutions. We believe that water supply should be available for all, not just a select few. This is the motivation behind our project and will be communicated throughout the report.

## Introduction

Mumbai, India is the country's most populated and developed city. It is the center of all major businesses and home of the successful Bollywood movie industry. This makes Mumbai one of India's wealthiest cities. Yet, the issue of water supply and quality is one of the city's biggest problems. Despite all the success in Mumbai, half of its population still resides in poverty, within slums. This is where inequalities have developed in regards to the wealthy having greater privileges than the poor. Approximately thirteen million people live in Mumbai today. Of that, about six million reside in slums or homes without built-in piping in order to provide running water (Ingall et. al, 2012). This leads to issues of lack of supply, unmonitored water use, improper waste water disposal, and pollution. But, this is only the second half of the equation. How is the water infrastructure set up before it reaches the people? The major managers of Mumbai's water system are the Brihanmumbai Municipal Corporation and the World Bank. Water is collected and distributed by a system that is at least 100 years old and treated by the largest water treatment plant in Asia (Mehta, 2012). The outdated system is coupled with outdated knowledge of how to properly operate and maintain it, which then causes the issue of revenue loss. This is where Mumbai becomes stuck in a loop because they need money in order to update their infrastructure but they don't have it because it is all being lost on trying to maintain the current one. In ten years, the population is estimated to increase by 25%, raising the census to sixteen million (3). With water literally leaking out of the system, it puts an even greater stress on being able to provide enough water to meet demand.

## Objective

The details of the current water infrastructure of Mumbai must be determined in order to form a hypothesis for its future. First, the current population of Mumbai has to be found in order to calculate the future population, approximately in year 2021. Then, determine where the water of Mumbai is being supplied and how that water is distributed. What are the problems associated with this current supply and distribution method? How will a larger population exacerbate these problems? After ruling out the most important issues, ideas can

start to be formulated about new policies or projects that can be implemented to help mitigate the effects of the growing population on the water infrastructure.

## **Hypothesis**

If there is no change to the current water infrastructure and water policies for Mumbai, there will be a shortage of supply and increased degradation of the water quality in the near future, due to a significant increase in the population.

## **Policy/Challenges**

Today, India is facing one of the largest population expansions that this world has ever seen, except maybe China. The city of Mumbai is one of the most populous cities in all of the country. The population of Mumbai today is estimated to be in the range of thirteen million people with a possible growth to about sixteen million by 2021 (Sule, 2009)! These numbers are staggering considering the fact this is only one city alone. As like most cities in India the challenge for the quantity and quality of water needed is at the forefront of all issues. There are two major problems when it comes to this water supply, one being that the infrastructure is crumbling and cannot withstand the demand for water, and second is the quality and amount that each individual has access to. These two things compounded with poor water policies makes for a real mess in Mumbai. Water policies are essential for proper distribution and management. Mumbai has some good policies in place and others that are harmful to the city. The Maharashtra State Water Policy is an example of a policy that is not doing any good for the city as a whole. Under this policy, they have placed agriculture water use priority below the urban water use priority. Water used for irrigation is being reallocated to the city center instead, wreaking havoc for the livelihood of farmers, and adversely everyone else, because food is something that is also in need by a lot of people in Mumbai. While this policy does put top priority on drinking water, it is not recognize, define, or ensure quality drinking water for all of the citizens. As in most cases, the wealthier individuals have access to the water they need, while they let the poor fend for themselves. This policy is also silent on the instrumental measures to ensure drinking water for all. Consequently, because of this policy, Municipal Corporations are getting the water based upon their population but distributing them

discriminately and exclude the marginalized from getting the proper amounts of water necessary (IELRC, 2003). Another policy that operates in Mumbai is the Maharashtra Water Resource Regulatory Authority (MWRRA). While this policy does have some positive aspects, there are some downfalls in this as well. This policy allows the setting of tariffs on different bulk water users including industry and small scale water users and farmers as well. This could lead to unfair pricing for water uses if they don't create an equal pricing breakdown. This policy has also introduced and implemented a tariff structure in which farmers in particular that have more than one child will have to pay higher prices for their water (IELRC, 2003). Regardless of how you feel about the subject, this tariff is a form of population control, and it is unfair that the burden lies with the farmers while all of the urban dwellers are not forced to pay. How is that going to help with population control? There are a lot more problems besides the ones talked about above. Low tariff rates, the policy of subsidy, low recovery rates, metering errors and billing mistakes burden the system (Sule, 2009). Some people go as far as saying that the wealthy are acting criminally with regards to distribution for the slums. There are proposed policy measures that will benefit and help ease the situation, but they rely heavily on citizen action, selflessness of corporations and the wealthy. As of now, that has yet to be seen, but there are many physical issues with the water system that are more pressing and need to be addressed.

## **Infrastructure**

There are many issues and problems with the water systems/infrastructure in Mumbai, India today. Most systems are in decay or in some places, non-existent. The current infrastructure in the city today is over one hundred years old and the maintenance is subpar by any standards. Their system works like this: monsoon precipitation is collected in six different service lakes where it sits until it goes to a treatment plant. The water is then sent to the Bhandup Water Treatment Plant, where they treat an average of four hundred sixty million gallons of water per day. The Bhandup Water Treatment Plant is the largest of its kind in all of Asia (PTI Agency, 2007). After going through treatment and sanitation, it is then sent to one of seventeen service reservoirs, where it is stored until needed, and then finally distributed

through six hundred fifty km transmission mains, three thousand km of distribution mains and three thousand two hundred km of service pipes where it is then finally able to be consumed by the citizens within the city limits (Sule, 2009). While these systems may be effective in other countries around the world, in Mumbai, this will not continue to work. The systems and infrastructure cannot keep up with the increasing population and an obvious increase in the demand for water. It is believed by both the World Bank and the Brihanmumbai Municipal Corporation that the city has access to enough water to supply the city for twenty four hours, but there's one big problem (Varghese, 2007). The infrastructure is in such bad shape, that unbelievable amounts of water are allowed to leak out and escape from piping and tunnels. When you add this to the fact that the city is only supplied with six hours of water per day, mass amounts of water is being lost and not enough brought in to keep up with the demand. It is estimated that the city of Shanghai, China loses on average in a twenty four hour time period, the same amount as the city of Mumbai loses in their small six hour window. This shows a great lack of money being put into maintaining and updating these systems. Even if the city did have enough time and money to update the whole system, a major problem is that city officials and workers are not even sure where pipes are located. This makes it extremely hard to fix leaks because no city piping maps have been completed, so finding the pipes and sources of leaks will prove to be very financially and labor intensive. Another problem with the leaky infrastructure in the city is that where these leaks occur, is where bacteria and other harmful contaminants grow and eventually get into the water supply. This creates excess contamination of the water supply in many parts of the city. The cases of water borne illnesses are staggering and most of which are caused by the pipe leak containments. With a city so populous and large it is hard to manage and maintain the systems in all of the parts. Efforts will be made by the current governing body to break the city down into smaller sectors and start improvements by this method (Varghese, 2007). A great deal of effort and money will need to be implemented by the agencies in Mumbai that control this water supply in order to raise the bar when it comes to the infrastructure of water systems in the city. With the population currently exploding these agencies will have to work fast and diligently in order to combat the crisis that they have before them.

## Water Agencies

The water governing agencies in Mumbai have an obvious serious situation on their hands. It is very hard to maintain water systems in a city with such a big population, and an infrastructure that is in serious need of repair. Most of this responsibility lies with the Brihanmumbai Municipal Corporation. The goal of the BMC is to ensure sanitation and health in connection with sewage and the water supply for the city. The BMC is in charge of seventy five percent of the water supply, maintenance, and sanitation throughout the city. The real discrepancy or problem with this agency is that it distributes more water to the urban downtown areas than it does to citizens in the rural areas, also considered the slums. By some estimates, the BMC provides the greater Mumbai area with around ninety lpcd, while it only provides the “slums” with about twenty five lpcd, which is well below an acceptable standard for human rights and health (Sule, 2009). Another agency involved with water systems throughout India, is the World Bank. While the World Bank does not exclusively work for the city of Mumbai, they are an instrumental tool in providing assistance to the city to better maintain and manage their water supply. They help city officials oversee different aspects and projects of their water system. The last system of management seen in Mumbai is by the private sector. While it is not a majority of the system, the private sector has seen some backing from the people. Some believe it would be more beneficial for the water to privately run, but as of now, these policies have had major opposition and that is why we still see the BMC in majority control. As Kisan Mehta, a renowned environmentalist, says “People are yet to come out of the mindset that water is naturally available and hence, a free commodity” (Sule, 2009). This is a troubling mindset in this situation because without knowing where the problem lies, nothing can, or will be changed.

## Recommendations

Due to the increasing number of water infrastructure challenges expected in the near future for Mumbai, a solution must be devised. Designing a resolution that meets rural and urban water demand was the goal of our project. For our solution, we proposed to work with Matt MacDonald and his engineering team. Matt McDonald engineered the Mumbai IV Water

Supply Project, which increased water supply to the Mumbai area by 15%. Water from the middle Vaitarna Dam was released to lower Lake Modak Sagar and drawn for treatment and city use. *Our Proposal is to: Create another dam in the Vaitarna River and divert more water towards Modak Sagar.* The benefits of this system are that: it has already been implemented, it is more cost-effective and it has shown to be successful. *Our other proposal is to: increase the use of rain water harvesting.* The Mumbai area is known to experience heavy monsoon flooding during the year. *Our recommendation is to make rain-harvesting devices mandatory for government buildings and to lower the cost of devices for consumers.* This way, water can be collected on top of rooftops in tanks and then treated for public use. It is a low cost solution. Desalination is another option that the Mumbai area can consider. There is an abundance of sea water present that can be put to beneficial use. *One more solution is to work with the Brihanmumbai Municipal Corporation and create more small scale water recycling plants.* The Brihanmumbai Municipal Corporation has constructed water treatment plants in the past and they have been shown to be very successful. It is estimated that 80% of the water that is distributed to Mumbai is discharged as wastewater (Sule, 2009). The potential to recycle this water and reuse it for public use is tremendous. This type of infrastructure can help meet the rising demand without having to place a large dent in the state or federal budget. The Vaitarna Dam project may not be beneficial for rural residents because most of them do not have the pipelines to obtain the water. But, it will help increase supply to the city and solve the urban problems. The rainwater harvesting and small scale recycling water plants will help solve the problem for the rural residents. *We also propose a policy to the federal government, which places a price ceiling on water costs for the rural/underprivileged residents.* By placing an adequate price ceiling, we can ensure equality for water resources. Most of the cost for our projects will be directed towards The Municipal Corporation of Greater Mumbai. The Indian Central Government should cover some of the costs and provide a helping hand. We have also devised a plan for the rural problem of sanitation. The approval and construction of these projects may take many years. So in the short term, we want to address the problem of sanitation. The rural/underprivileged residents are forced to obtain their water from the cheapest possible sources. These sources may include: lakes, rivers and even sewage systems.

*So we propose that a cheap “Tea Bag Water Filter” system be implemented.* This type of water purification system has been implemented in Africa at a small scale and has shown to be successful. Traditional tea bags are filled with carbon granules and the outside contains biocides, which kill bacteria. This tea bag is placed into a water bottle or jug and can absorb and filter out all of the harmful contaminants (Saenz, 2010). It is extremely cheap to implement this system and has the potential to save millions of lives. It is scientifically shown to remove 99% of the harmful contaminants. Overall, the tea bag only costs about ½ cent to filter 1 liter of water. Our goal will be to have the local government supply the tea bags to the rural residents free of charge. This would help save many lives and decrease health related costs in the long run.

## **Conclusion**

With the population of Mumbai expected to grow by 25% in 2021, water supply and management will surely become a central issue. The current water system is around 100 years old and lacks adequate construction. The system is faulty and leads to demand shortages in the Mumbai area. The challenges are faced by the urban and rural residents. The water supply in Mumbai also poses a problem of inequality. Even when the system does provide enough water, it is not distributed in a rational manner. The more wealthy residents are able to gain access to the water supply, while the rural/underprivileged residents are left fighting for their lives. The current water infrastructure is infested with bacteria due to its age and the rural residents are left to face its consequences. Some solutions have been developed in the area by Matt McDonald and his engineering team. Through new infrastructure, they have increased supply to the area by 15%. Our project focused on finding solutions to meet the future demand. We proposed to: create another dam in the Vaitarna River, implement rain-harvesting devices and to construct more small scale water recycling/treatment plants. Our goal is to create change in the Mumbai area and allow water supply to be distributed consistently (to meet demand) and fairly (to supply rural residents). Greater action will have to be taken by the Mumbai water agencies and local governments. Water supply is a necessity



and it affects the welfare of the local residents. Small children and older adults are suffering. It is up to Mumbai to create the change that it needs.

## Limitations

The limitation for our project is going to be involved with funding. We have devised a plan to fund the projects but it is up to the local government and federal government to collaborate. Mumbai is not currently investing a lot of money in water infrastructure. Instead, they are renovating the old systems because it is the cheaper option. Thus, getting them to invest more money into a plan that is developed for the future will be a challenge.

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