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Analysis of the Water Shortage Situation in Darjeeling Town

Sarvesh Kumar Roy
Ph.D. Student, Department of Geography, University of Calcutta, Kolkata, West Bengal, India

Corresponding Author: kumarsarvesh36@gmail.com

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ABSTRACT
Water is essential to life and plays a crucial role in our day-to-day activities. It is also an imperative necessity. Water provision is one of the most crucial public services offered by Darjeeling Municipality. The main water supply sources in Darjeeling Town are natural springs, which are mostly dependent on the local geography and rainfall. People from all walks of life in Darjeeling are aware that the twin Senchal lakes (South Lake, built in 1910, with a capacity of 13 million gallons, and North Lake, built in 1932, with a capacity of 20 million gallons) that supply drinking water to the town come from a 15-kilometre stretch of perennial springs away from the town of Darjeeling. Only 14 springs remain out of 26 due to rampant deforestation and unlawful development close to the catchments. According to the report, Darjeeling Municipal Town continues to struggle with its high water storage levels and low per-person water availability. A daily supply of 15–18 lakh gallons of water is needed in Darjeeling. The municipality can only supply roughly 7-8 lakh litres during the dry season. With 21,782 houses and more than 1.18 lakh residents as of today, Darjeeling town is expected to see an additional 1 to 2 lakh residents with the opening of new schools, colleges, and tourist attractions. Since there is a lack of water in this hill town, it follows that the residents of Darjeeling Town must rely on rainwater collection and private water delivery.

Keywords: *water shortage, wildlife, rainfall, tourist place, sources, culture structure*

I. INTRODUCTION

For humans to survive, water is a necessary natural resource. One of the most fundamental human requirements and a vital lifeline in any urban setting is access to a safe and consistent supply of water. Water resources are used for a variety of purposes worldwide because they are essential to almost all human endeavours. Scholars have produced a large body of work on water issues both in the past and present, including Dieterich and Henderson (1963), Morehouse (2000), Maksimovic (2001), McKenzie and Ray (2009), Sivrama krishnan and Sarkar (2011), Sen Gupta (2011), Chiplunkar, Seetharam & Tan (2012), and Bahri (2012), to name a few. These scholars are interested in integrated urban water management, waste water management, climate change and urban water demand, water supply networks and sustainable development, urban water sector improvement projects, urban water quality, urban drainage principles, urban water use, reform options, and potential lessons, among other topics. A town's health, function, vitality, potential, and sustainable development all depend on having a reliable supply of clean water. Water shortages have become a severe problem in recent years due to the increasing constraints on urban water supplies brought on by the fast-growing urban population. Water is a limited, scarce, fragile, and susceptible resource.

II. DESCRIPTION OF THE PROBLEM

Lack of alternate sources, such as wells or drilled wells, which are typical on the plains, has made water scarcity a major cause for concern in the Darjeeling hills. The physio-cultural structure of the Darjeeling Hill area has been severely altered ever since the British occupation. With the arrival of man, his interference with nature, and numerous developmental activities, including increasing cultivated land, expanding tea plantations, unrestrictedly growing communities, and building highways, the vegetal cover has been drastically reduced. The water resources in this area have been tainted by all these bad human behaviours.

As a result, there is a significant water issue in Darjeeling town, especially during the dry seasons when it is impossible for the municipality and P.H.E. department to maintain the regular water supply because the majority of the springs in and around Darjeeling dry up. A holistic approach to managing water resources is essential for ensuring a sufficient and comfortable supply for Darjeeling town's residents because widespread water scarcity and misuse pose a serious and growing threat to sustainable development and environmental protection. This calls for integrated water resource planning and management.

III. THE AREA OF THE STUDY IS DEFINED

On the Darjeeling-Jalapahar range, which rises in the south from Ghum, Darjeeling is situated in the Darjeeling Himalayan hill region at an average height of 6,982 feet (2,128 metres). The range is Y-shaped, with two arms separating north of Observatory Hill and the base lying at Katapahar and Jalapahar. The northwestern arm crosses via North Point and finishes in the valley next to Tukver Tea Estate, but the north-eastern arm falls abruptly and ends in the Lebong spur.

The northern region of the Indian state of West Bengal is home to Darjeeling, also referred to as the "queen of the Himalayas." West Bengal's lone and most well-known hill station is Darjeeling.

Despite having its centre in the well-known Darjeeling hill town, Darjeeling is a large district. The Tibetan terms "dorje," which means a thunderbolt (originally, the sceptre of Indra), and "ling," which means a location or region, are the source of the name "Darjeeling," which translates to "the land of the thunderbolt." Darjeeling earned the title "Queen of the Hills" thanks to its pleasant climate, stunning scenery, and everyone's smiles. Darjeeling is a popular tourist destination throughout the country and the world, especially during the summers due to its pleasant climate. Despite being a small hill town (about 4 square miles or 10.4 square kilometres), Darjeeling is known for its scenic beauty, snow-clad Himalayas, and tea gardens.

IV. GOALS AND OBJECTIVES

The current study aims at the following specific objectives in addition to its basic objective, which is to assess the availability of water resources in Darjeeling town:

1. In order to assess the current situation and the public water supply options in Darjeeling Town,
2. In order to pinpoint the current sources and accessibility of drinking water for town people,
3. To pinpoint the current issues with the town's water supply system,
4. To compare population growth with changes in water supply and demand,
5. The analysis of the difficulties facing the town's water delivery system is the ultimate goal.

V. DARJEELING TOWN'S LAYOUT

The top level of Darjeeling town, where Chowrasta Mall, also known as the Town Centre, is located, is the most sought-after area for tourists because it is where the majority of well-known hotels, restaurants, and shops are situated. The top level is essentially the entirety of Nehru Road, which leads up to the Mall, the Mall Road itself, and the lower two levels of the town as well.

Other areas on the second level include the places along H. D. Lama Road, Robertson Road, etc. Here too, you will find several popular hotels and shops, but they are not as expensive as some of those at the top level. On this middle level, you will find many Indian-style hotels and shops, some offering nice views. The second level is essentially the area along Laden La Road, which goes down and connects the top level with places like the station area, Chowk Bazaar, etc. at the bottom level.

The popular Chowk Bazaar, or Lower Bazaar, which extends up to the Darjeeling Station to the south and up to North Point (St. Joseph's College) and Lebong to the north, is located on the lowest level, or bottom level, and is always crowded and bustling with locals, mostly Nepalese, Tibetans, Lepchas, and Bhutias.

VI. PRESSURE OF POPULATION IN DARJEELING TOWN

The process of urbanisation in Darjeeling town has been significantly influenced by population expansion and demographic change. Darjeeling Town had a population density per square kilometre of 2,675 in 1951. This increased to 6,912 per km2 in 1991, then to 10,141 per km2 in 2001, and then significantly to 11,240 per km2 in 2011. According to the 2011 census, there are 1,18,805 people living in the 10.57 km2 urban agglomeration of Darjeeling town. Additionally, the town has a 20500–30000 average daily floating population, primarily made up of tourists and other visitors. About 31% of the town's residents live in slums. This is the outcome of the region's unprecedentably rapid urban expansion as a result of unsustainable migration (mostly low-wage earners) seeking better opportunities.

Only 22,607 people were counted in the 1869 census as living inside the boundaries of the Darjeeling Municipality, which corresponds to the original tract that the Rajah of Sikkim relinquished in 1835. Darjeeling, a British town, was built to accommodate just 10,000 people. In light of the region's recent geological youth, numerous environmental issues, and consequently unstable character, the town's population boom has made it more vulnerable to environmental issues. The appeal of Darjeeling to tourists has been negatively impacted by environmental degradation. Table 1 shows that there were only 16,924 people residing in Darjeeling town in 1901.

Year	Population	Growth
1901	16924	.
1911	19005	+12.3
1921	22258	+17.1
1931	21185	.04.8
1941	27224	+28.5
1951	33605	+23.4
1961	40651	+21.0
1971	42873	+5.5
1981	57603	+3.5
1991	73062	+26.8
2001	107197	+46.7
2011	118805	+10.8

Source: Census of India & Darjeeling Municipality

However, as of the 2011 census, there were 1,18,805 people living in Darjeeling Town, which also happens to have the oldest municipality in the Hills, having been founded in 1850.

VII. RESULTS

7.1 Current Water Shortage in Darjeeling Town

Water is essential to life and plays a crucial role in our day-to-day activities. It is also an imperative necessity. Water provision is one of the most crucial public services offered by Darjeeling Municipality. The Senchal Forest and Wildlife Sanctuary, which is around 15 km from the main town, is the catchment region for 26 different springs that make up Darjeeling's water supply system. The 8 km long Masonry conduit system, which supplies water to the twin Senchal lakes by gravity, receives water from springs after being collected in an Arrestor tank.

Due to its captivating natural beauty, Darjeeling is renowned as the "Queen of the Hills" for a variety of reasons, including water scarcity. The population of Darjeeling (town) has increased through time and is now nearing 2 lakhs; however, Senchal North and South Lake remain the only water sources available to meet Darjeeling's needs. During the British era, it was originally built to accommodate only 25,000–30,000 Darjeeling residents. Apart from a little money thrown here and there without any real impact, it appears that nothing significant has been done to address the Darjeeling water situation since India gained independence from the British in 1947. The Balasun project, whose foundation stone was placed in 2005 to address the issue of water scarcity, was the largest project. The River Balasun is located 13 kilometres from Senchal Lake. Although the project was initially scheduled to be finished in 2009, eight years have passed, and it is now almost finished. Senchal Lake's level has fallen as of late. Due to the Senchal Lake's irregular presence of water, the municipality, which is primarily in charge of water distribution, is powerless. It is apparent that the lack of reservoirs is one of the key causes of the water deficit.

Due to the lack of water, people have taken a number of steps to ensure that there is always enough water to cook with and drink in their homes, whether they beg, borrow, or steal it. Homes with municipal water connections run out of water because water is stolen from their pipes and tampered withwith and drink in their homes, whether they beg, borrow, or steal it. Homes with municipal water connections run out of water because water is stolen from their pipes and tampered with. Ironically, the hamlet is supposed to receive 2812 inches of rain annually.

Mm, one of India's greatest yearly rainfall totals. One would anticipate that water would be easily gathered given the amount of rainfall. Unfortunately, there are no facilities for collecting water. Water is visible running in large drains during the rainy season, but it can only be retrieved up to a certain extent. The North Lake can retain 20 million gallons before overflowing, while the South Lake has a total capacity of 13 million gallons. Water waste amounts to millions of gallons. If properly stored, this amount of rainfall might contribute significantly, if not entirely, to resolving the water crisis.

In Darjeeling, there is a huge need for water. Many people have been interested in this chance to sell water, and their businesses grow all year long. People in Darjeeling typically buy water from tankers that transport it from numerous streams located far from the main town. A purchase of 5000–6000 litres of water would set you back about Rs. 900–1000. One of the top tourist spots in India is Darjeeling. Just getting water for the tourists is a huge undertaking for these hotel owners. The influx of tourists raises the need for water. The hotel owners purchase about two to three tankers of water every day during the tourist season. But not many hoteliers, especially those that run low-cost establishments, have the money to purchase that much

water. As a result, Darjeeling's tourism industry is severely impacted. Tourists staying in small motels are only given one or two buckets of water. People from all across the town purchase water, in addition to hoteliers. It is now a common occurrence.

7.2 System of Providing Water

Currently, it appears that the 26 natural springs are the source of water. The water flows directly into the conduit from there and is collected at Senchel in below-ground storage reservoirs by gravity. Thos. Kenay, the Darjeeling Municipality's first engineer, built the North Lake and South Lake in the years 1910 and 1932, respectively. The Honble Lady Jackson officially opened Twins Lake on February 28, 1932. These lakes were primarily intended for a population of 10,000 people. The population has recently increased quickly and is now insufficient, especially during the dry season. One of the main causes is that, despite the lakes' lifespan of more than 78 years, only spot repairs and not comprehensive renovations have been carried out to date. The two lakes are experiencing seepage. A suicide-related case is seen every year because of the deteriorating condition of the fencing. It is particularly challenging to keep an eye on the region at night due to the size of the area, the lack of street lighting, and the poor quality of the sidewalks.

Except for service lines and public hydrants, the Darjeeling Town Water Supply System has 83 km of distribution main and 35 km of transmission main, along with a number of valves. When water delivery through pipelines was introduced in Darjeeling town, over 95% of the pipelines and valves were installed. Since the majority of repair and restoration work was done exclusively on an as-needed basis, not a single project was ever undertaken to replace outdated pipelines or leaky valves. This is one of the causes of the leaks, which are evident throughout the town and have a negative impact on the water supply in general. As a result, before implementing the redistribution system, attention needs to be given to the realignment and replacement of pipes and valves. Four of the fourteen pipe line bridges along the gearbox main, which are on the verge of collapsing, require emergency repair or reconstruction.

The quick sand filtration plant, located near Jorebunglow Filter House, is treating the water. Rapid sand filters remove particles and contaminants that have been caught in a floc by the use of flocculation chemicals, often salts of aluminium or iron, by using relatively coarse sand and other granular media. Under the influence of gravity, water and flocs pass through the filter media, with the flocculated material becoming trapped in the sand matrix. Layers of gravel and filter media (such as sand, anthracite, etc.) are present inside the filter box. The underdrain, which gathers the filtered water and evenly distributes the backwash water, is a system of pipes that is located below the gravel. Backwash troughs are used for both backwashing and distributing influent water. In addition to the components listed above, the majority of rapid sand filters include a controller, often known as a filter control system, that controls the rate at which water passes through the filter. While cleaning the filter, additional components are used, including valves, a loss of head gauge, surface washers, and a backwash pump. The influent is caught by the underdrain after flowing through the sand and support gravel. But because of coagulation, flocculation, and sedimentation, the influent water in a rapid sand filter is already rather pure, so rapid sand filters work much more quickly.

The existing water supply infrastructure was designed to serve a population of roughly 15,000 (fifteen thousand) between 1910 and 1915. Subsequently, several water supply infrastructures, including Khangkhola Station, the Rambi water line, Sindhap Lake (capacity 15 million gallons), Bokshi Jhora, and Bangla Khola, were added. However, these infrastructures were unable to keep up with the rapid increase in population, which is why the demand for drinking water, particularly during the dry season, The situation, however, peaked in the last few years or so due to a sharp decline in the amount of water at natural springs in the catchment area brought on by widespread unlawful tree cutting. The population of Darjeeling Town is currently over 1.18 lakh, and with the start of the academic year, the start of the tourist season, and the onset of the dry season (March to May), an additional 40 to 50 thousand floaters are added to the total population, making the total population of the town around 1.68 lakh, for which water must be provided.

7.3 Water Shortage Issues in Darjeeling Town

Today, it is a well-known fact among Darjeeling residents from all walks of life that the town's drinking water comes from the twin Senchel lakes (South Lake, which was built in 1910 with a capacity of 13 million gallons, and North Lake, which was built in 1932 with a capacity of 20 million gallons), which draw their water from 26 perennial springs in the Senchel Catchments Area. These lakes were built by Thos. Kenay, the first engineer of the Darjeeling

These two lakes have a combined volume of 33 million gallons. Gravity pressure filters at the Jorbunglow Filter House are used to filter water, which is then sent by sizable conduits to reservoirs erected in Rockville and St. Paul, each of which has a capacity of 1,14,000 gallons and 2,35,812 gallons, respectively. Operating valves not only near the main tank at St. Paul and Rockville but also in many other locations across the city is how the entire distribution network is run. There are more than 90 such valves located across the town in total. If these valves are not opened synchronistically by the several valve men at different locations, many portions of the town won't have access to water. As a result, this region will be subject to the whims of the Valves man and mistakes made by people, which will inevitably result in corruption to some extent.

The main water supply sources in the hills are water springs, which are mostly dependent on geography and rainfall. Therefore, protecting the catchment area that supplies such springs is absolutely crucial. The catchment area needs to be

preserved properly. Only 14 springs remain out of 26 due to rampant deforestation and unlawful development close to the catchments.

A third lake with a capacity of 15 million gallons was built by the Government of West Bengal at Singdhap in 1978, but due to poor reservoir quality and leakage, it is a nearly dead lake. During the rainy season, the collection of water at Senchal Catchments Area becomes sufficient from 8 to 10 springs; the rest of the springs have to be cut off due to the limited capacity of reservoirs at Senchal Lakes. It is vitally necessary to build more reservoirs in the Senchal area due to the area's expanding population, booming geometrical ratio, and tourist influx.

If this initiative is not taken at the proper time, there won't be any space left unoccupied for this purpose in the near future. In addition to the need for the construction of an additional large reservoir in the Senchal area, there is also a need for the construction of various sizes of subsidiary tanks in every village and ward, depending on the available space.

The municipal town of Darjeeling continues to experience problems with its per-capita water resources and heavy water storage. Only 50% of municipal houses have access to the public water system. The historical water issue has gotten worse due to the growing disparity between supply and demand. Water supply statistics unmistakably show that such businesses will proliferate in the near future. The average amount of water needed in the town of Darjeeling is 15 lakh gallons; however, only 5 lakh gallons are actually available. This translates to a daily water supply per person of 22 litres, compared to the national average of 70 litres. There is also no consistent supply of water there. Water is delivered once a week to several municipal areas. It is given to the lucky one every four days. The paradox is that Darjeeling has one of the highest rainfall rates in the nation. Since most individuals in Darjeeling don't have large water tanks, buying tanker and handcart loads frequently causes storage issues.

For the past thirty (50) years or more, Darjeeling Town has experienced a drinking water shortage. Plans like Sindhap Lake, Bangla Khola, and the Initial Scheme for Rambi Water tapping of springs at various areas were made in the past to try and solve the problem, but it remained unsolved. Finally, a comprehensive Rambi water supply plan was implemented in the past with an increase in total production of 1.5 lakh gallons per day; however, the second phase of the scheme was abandoned despite being sanctioned, according to the report of PHE (Public Health Engineering).

VIII. CONCLUSION

Darjeeling has enough water resources to suit all of the city's residents' needs. Darjeeling enjoys abundant rainfall. In India, the yearly rainfall is among the highest. Groundwater gushes forth in the form of springs because of the steep terrain. Rapid urbanisation, deforestation, the drying up of water sources, and last but not least, an enormous amount of development activity occurring in a congested area have all placed considerable stress and strain on Darjeeling's water resources in the past ten years. Darjeeling town, a popular tourist destination with a number of prestigious educational institutions and a thriving tea industry, is rapidly growing in population. Population density increased by 46.7% between 1991 and 2001 and by 10.8% between 2001 and 2011, and it is continuously rising, which is driving up water demand. A total of 2,18,000 MG of water from Jhoras is currently kept in three lakes and provided to the town. In non-lean periods, there is a deficiency of supply of 0.30 MLD (million litres per day), while during lean periods, it increases to 6.31 MLD. More reservoirs might be built to fill this gap; however, Senchal Ridge is not an ideal location for such reservoir development. Taking into account the average annual rainfall of 2973 mm, the amount of net yearly rainwater that is available in Darjeeling town is 19 MCM (million cubic metres), which will only be used to cover 16.5% of the town's annual water requirement. People only receive water now once every three or four days, and for a very brief time, even during the rainy season. However, during the dry season (March, April, and May), water is delivered every six to fourteen days. Despite the fact that there are enough resources to meet everyone's needs, the government is unable to harness these resources to make them suitable for drinking. Therefore, in the highlands, long-term, careful planning is crucial for the efficient management and upkeep of the limited water supplies in a sustainable manner.

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