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A Situational Analysis of Water Resources in Darjeeling Municipal Town: Issues and Challenges

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Abstract: *Water is life and is an absolute basic necessity which plays a very vital role in our day to day life. One of the most important civic amenities provided by Darjeeling Municipality is supply of drinking water. Sources of water supply in the Darjeeling Town are mainly the natural springs; these springs directly depend upon the topography and its rainfall. It is a known fact to the people of Darjeeling from every walks of life that the Darjeeling Town is supplied with drinking water from twin Senchal lakes (South Lake with capacity of 13 million gallons built in 1910 & North Lake with capacity of 20 million gallons built in 1932) having its source from 26 number of perennial springs in the Senchal Catchments Area, which is 15 kms. away from Darjeeling Town. Now due to indiscriminate deforestation and illegal construction near the catchments area, out of 26 springs only 14 springs are continue to exist. The study reveals that Darjeeling Municipal Town is still suffering by the heavy storage of water supply and the per capita availability of water in the town. Darjeeling requires a daily supply of about 15-18 lakh gallons of water. During the dry period, the municipality can supply only about 7-8 lakh gallons. The present population of Darjeeling town is more than 1.18 lakhs with 21,782 number of households and with the opening of schools, colleges and tourist flow, population is added by another 1 to 2 lakhs. Therefore it is to conclude that the people of Darjeeling town have to depend on rain water harvesting and on private water carrier because of scarcity of water in this hill town.*

Keywords: *Municipality, water, town, springs, distribution system.*

1. INTRODUCTION

Water is an essential natural resource for human existence. A safe and reliable supply of water is one of the most basic of human needs and is an important lifeline in any urban area. There is a multi-interest utilization of water resources everywhere as water is needed for virtually every human endeavour. Numerous worldwide literature works on water issues have been carried out by the scholars with different methodologies and viewpoints in the past and at present like Dieterich and Henderson (1963); Morehouse (2000); Maksimovic (2001); McKenzie and Ray (2009); Sivramakrishnan and Sarkar (2011); Sen Gupta (2011); Chiplunkar, Seetharam & Tan (2012); Bahri (2012) to quote a few. The issues taken up by these scholars are integrated urban water management, waste water management, climate change and urban water demand, water supply network and sustainable development, urban water sector improvement project, urban water quality, urban drainage principles, urban water use, reform options and possible lessons etc. Having a secure supply of clean water to a town is of fundamental importance to its health, function, vitality, potentiality and for its sustainable development. But in recent years, on account of the growing pressures upon urban water supplies due to rapidly increasing urban population, water scarcity has become a serious issue as it is a finite, scarce, fragile and vulnerable resource.

2. STATEMENT OF THE PROBLEM

In the absence of alternative sources like wells or dug wells which are common in the plains, water scarcity has become a major issue of concern in Darjeeling hills. Ever since the British occupation, the physio-cultural set up of Darjeeling hill area has been seriously disturbed. The vegetal cover has been reduced to a minimum with the advent of man, his interference with the nature and various developmental activities like increase in cultivated land, extension of tea plantations, unlimited and unplanned expansion of settlements and construction of roads. All these faulty human practices have vitiated the water resources in this region.

Consequently, water shortage becomes a severe crisis in Darjeeling town particularly during the dry seasons when the P.H.E. department and the municipality find it difficult to maintain the regular water supply as most of the springs in and around Darjeeling go dry. As widespread water scarcity and misuse of water pose a serious and growing threat to sustainable development and protection of the environment, immediate and effective action for management of water resources with a holistic approach is of foremost importance and therefore demands an integrated water resource planning and management for an adequate and comfortable supply to the residents of Darjeeling town.

3. DELINEATION OF THE STUDY AREA

Darjeeling is located at an average elevation of 6,982 ft (2,128 m) in the Darjeeling Himalayan hill region on the Darjeeling-Jalapahar range that originates in the south from Ghum. The range is Y-shaped with the base resting at Katapahar and Jalapahar and two arms diverging north of Observatory Hill. The north-eastern arm dips suddenly and ends in the Lebong spur, while the north-western arm passes through North Point and ends in the valley near Tukver Tea Estate.

Darjeeling, known as the queen of the Himalayas is situated in the Northern Part of the Indian state of West Bengal. Darjeeling is a popular and only hill station in the state of West Bengal.

Darjeeling is actually a widespread district although the popular Darjeeling hill town is the nucleus of the place. The name 'Darjeeling' came from the Tibetan words 'dorje' meaning thunderbolt (originally the scepter of Indra) and 'ling' is a place or land, hence 'the land of the thinderbolt'. With its temperate climate, magnificent nature and happy smiling faces all around, Darjeeling came to be called as Queen of the Hills. While the hill town is quite small (about 4 square miles or 10.4 square kilometers. Known for its scenic beauty, snow-clad Himalayas, and tea gardens, Darjeeling is frequented by tourists from all over the country as well as from around the world. Especially during the summers, the place is a preferred destination due to its pleasant weather.

4. AIMS & OBJECTIVES

Evaluation of the availability of water resources in Darjeeling town continues to be the main objective of the study. The present study aims at the following specific objectives:-

[1] To evaluate the present scenario and public water supply provisions in Darjeeling town,

[2] To identify the present sources and availability of drinking water amongst the town residents,

[3] To identify the present problems related to water supply system in the town,

[4] To correlate the growth of population with that of water supply & demand,

[5] And the ultimate aim is to analyze the challenges for the water supply system in the town.

5. MATERIALS AND METHODS

For attaining the objectives, the research follows an exploratory as well as explanatory approach based on the analysis and interpretation of both primary and secondary data. Both empirical and descriptive method has been sought for the purpose. While the empirical method focuses on obtaining findings numerically from primary data and use of descriptive statistics, the interview of the authorities associated with water supply, perception study of the resident community and evaluation of urban water generation mechanism through archival record also provide a space for using qualitative as well as descriptive method in the study. Observation and personnel interview were also carried on in waterworks department of Darjeeling Municipality and few general public regarding water related issues.

6. SIGNIFICANCE OF THE STUDY

Water is a very important natural resource, we use water for almost every activity like drinking, washing, cooking, cleaning, etc. This precious resource is largely getting wasted due to human carelessness and lack of planning and hence we are facing the scarcity of water. According to United Nations, a person needs a minimum of 50 liters of water per day for his basic needs of hygiene, cooking and drinking. But there is a large population which fails to receive this small quantity of water and hence most of the population is getting affected by water scarcity. Insufficient intake of water causes kidney problems, constipation, and various mental changes. Blood pressure and heat flow in our body are maintained by water. The usable water present on earth, therefore, needs to be saved in order to live a healthy and sustainable living.

Even though about 71% of earths surface is covered with water, most of this water is not fit for consumption. Freshwater is the only source of useful water which is present in very small quantity thus limiting the accessibility to potable water. Rainwater is an important source of fresh water. It needs to be harvested so that it can be put to use. Human society is overusing water and in many cases wasting it. Loss of water due to leakages, excessive use of water for washing purposes, taps left open after use are some common sights that form the basis of the problem of water scarcity. Due to the large increase in population, the demand is much more than supply and has hugely increased the consumption of water.

7. LAYOUT OF DARJEELING TOWN

The layout of Darjeeling town can be visualized as having three landing areas or levels. And each level is connected to the other by steep narrow roads. Chowrasta Mall which is often known as the Town Center, is located at the top level. The top level is therefore the most coveted area for the tourists. This is where most popular hotels, restaurants and shops are located. The top level is essentially the whole of Nehru Road which leads up to the Mall, the Mall Road itself, and a part of Gandhi road. Although the area along Zakir Hussain Road which originates from the Mall and goes uphill towards the famous St. Paul's School is also part of the top level, but being further off from the town center, the tourist demand for this area is not as much. There are however several hotels that have come up along Zakir Hussain Road. Many hotels at the top level offer great views of the Kanchenjunga snow peaks.

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

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

8. POPULATION PRESSURE IN DARJEELING TOWN

Population growth and demographic change have played a determining role in the process of urbanization in Darjeeling town. The density of population per square kilometre of Darjeeling town was 2,675 in 1951, which went up to 6,912 per km² in 1991 and from there to 10,141 per km² in 2001 and substantially increase to 11,240 per km² in 2011. As per the 2011 census, the Darjeeling town urban agglomeration with an area of 10.57 km², has a population of 1,18,805 persons. Also, the town has an additional average diurnal floating population of 20500 - 30000, mainly comprising of the tourists and visitors. The town houses about 31% of its population in the slums. This is the result of the unprecedented urban growth due to the unsustainable migration in the area (mainly the low class wage earner) for better opportunity.

Table: 1

Population Growth in Darjeeling

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

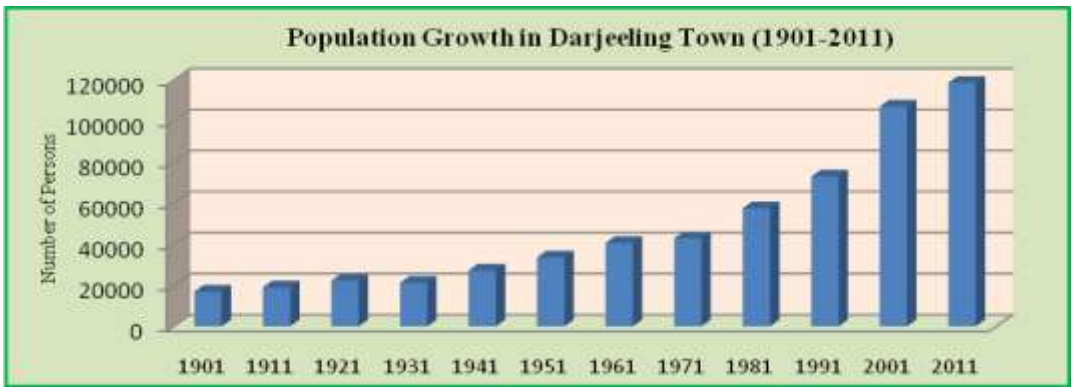

Figure1

The census taken in 1869 for the inhabitants within the limit of Darjeeling Municipality area, corresponding to the tract originally ceded by the Rajah of Sikkim in 1835, recorded a total population of 22,607 persons only. The colonial town of Darjeeling was designed for a mere population of 10,000. So the population spurt has made the town more prone to the environmental problems in recent decades as the region is geologically relatively new with hosts of environmental problems and hence unstable in nature. Environmental degradation has adversely affected Darjeeling's appeal for tourists. It is observed from the Table-1 that in 1901 merely 16,924 persons only used to live in Darjeeling town. But at present the urban population in Darjeeling town has reached to 1,18,805 persons during 2011 census period which happens to have the oldest Municipality in the hills, formed as far back as 1850.

9. RESULTS AND DISCUSSION

9.1. Situational Analysis of Water Scarcity in Darjeeling Town

Water is life and is an absolute basic necessity which plays a very vital role in our day to day life. One of the most important civic amenities provided by Darjeeling Municipality is supply of drinking water. The water supply system of Darjeeling town consists of tapping of 26 numbers of springs from the catchment area of Senchal Forest and wildlife sanctuary located about 15 km away from main town. The water from springs are collected in an Arrestor tank and fed to the Masonry conduit line (about 8 km in length) which brings water on gravity to twin Senchal lakes.

There are various reasons behind water scarcity in Darjeeling, known as the 'Queen of the Hills' due to its mesmerising natural beauty. "The population of Darjeeling (town) has grown over the years, as it stands close to around 2 lakhs, but still we just have Senchal North and South lake to cater to the water demands of Darjeeling. It was actually constructed to meet the demands of only 25,000 – 30,000 Darjeeling citizens under the British period. India attained Independence from the British in 1947, after which nothing substantial seems to have been done to solve the water crisis in Darjeeling, apart from some money splattered here and there without any success. The biggest project was the Balasun project, whose foundation stone was laid in 2005 to end the problem of water scarcity. Balasun is a river - 13 kms away from Senchal lake. Eight years passed, and the project is nearing its end, though it was originally supposed to be completed in 2009. At present, the level of Senchal lake has gone down. The municipality, which is primarily responsible for the distribution of water have their hands tied, as the Senchal lake does not have water present on a regular scale. It is obvious that one of the main problem of the water scarcity is due to the shortage of reservoir.

Due to water scarcity, people have adopted various measures so as to make sure that there is enough water to drink and cook in one's home irrespective of how water reaches one's residence beg, borrow or steal. Those houses that have a municipality water connection lose out on water, as their pipes are tampered with and water is stolen. It is ironic, as the town is said to receive an annual rainfall of 2812 mm - one of the highest rates of annual rainfall in India. With such heavy rainfall, one would expect water to be easily harvested. Unfortunately, there are no water harvesting facilities. During the rainy season, water is seen flowing in huge drains – it can be harvested only till a certain point. The South lake can hold a total capacity of 13 million gallons and the North lake 20 million gallons after which it overflows. Millions of gallons of water go waste. This quantity of rainfall if properly stored would play an important role in solving the water crisis, if not in its entirety.

The demand of water is very high in Darjeeling. There are many people who have eyed this opportunity to sell water and their business blossoms throughout the year. Normally, people in

Darjeeling have made it a habit of buying water from tankers that get water from various streams, which are far off from the main town. The cost of buying 5000-6000 litres of water costs around Rs. 900-1000. Darjeeling is known as one of the best tourist destinations in India. These hoteliers face a herculean task just to provide water to the tourists. The demand for water increases with the tourist influx. During the tourist season, the hoteliers we buy around 2-3 tankers of water everyday. But not all hoteliers are able to buy such quantity of water, especially budget hotels. Hence, the tourism sector in Darjeeling is hit hard. Small hotels only provide one or two buckets of water to the tourists. It is not only hoteliers that buy water, but also people all over the town. It has become a regular phenomenon.

9.2. Water Supply System

At present the 26 nos of natural springs seems to serve as the source of water. The water enters the conduit directly from it and by gravity the water is collected in ground storage reservoirs at senchel viz. the North Lake and South Lake, constructed by Thos Kenay, the first engineer of Darjeeling Municipality in the year 1910 and 1932. The twins lake was being inaugurated by the Honble Lady Jackson in the year 28th Feb 1932. These lakes were mainly designed for 10,000 populations only. Now the population has grown up rapidly and it is insufficient mainly for the dry season. One of the most important reasons behind it is that, since the life span of the lakes is more than 78 years, till yet no thorough renovation work has been done, except small patches work. Both of the lakes are in seepage condition. As the fencing is in deteriorated condition there is suicideable case every year. As the area is huge and no provision of street light and worse condition of footpaths it is very difficult to supervise the area at night.

Darjeeling Town Water Supply system has about 35 km of transmission main and 83 km of distribution main (excluding service lines and public hydrants) and a number of valves. Almost 95% of the pipelines and valves were laid at the time of introducing water supply through pipeline in Darjeeling town. Not a single work was done in the past to replace the old pipelines or leaking valves and very little maintenance works were taken up since most of the repair/restoration works were taken up on ad-hoc basis only. This is one reason as to why the leakages are noticed in so many places of the town and adversely affecting in the general water supply. As such, priority needs to be given for re-alignment and replacement of pipelines and valves before going in the system of redistribution. There are 14 pipe line Bridges along transmission main out of which 4 of them require immediate repair/ reconstruction as these are about to collapse.

The water is being treated by the rapid sand filtration plant situated at Jorebunglow Filter house. Rapid sand filters use relatively coarse sand and other granular media to remove particles and impurities that have been trapped in a floc through the use of flocculation chemicals - typically salts of aluminium or iron. Water and flocs flows through the filter medium under gravity pressure and the flocculated material are trapped in the sand matrix. Inside the filter box are layers of filter media (sand, anthracite, etc.) and gravel. Below the gravel, a network of pipes makes up the underdrain which collects the filtered water and evenly distributes the backwash water. Backwash troughs help distribute the influent water and are also used in backwashing. In addition to the parts mentioned above, most rapid sand filters contain a controller, or filter control system, which regulates flow rates of water through the filter. Other parts, such as valves, a loss of head gauge, surface washers, and a backwash pump, are used while cleaning the filter. The influent flows down through the sand and support gravel and is captured by the underdrain. However, the influent water in a rapid sand filter is already relatively clear due to coagulation/flocculation and sedimentation, so rapid sand filters operate much more quickly.

The existing water supply installations were meant for a population of about 15,000 (fifteen thousand) during the year 1910-1915, thereafter a number of water supply installations, like Khangkhola Station, Rambi water line, Sindhap Lake (capacity 15 million gallons), Bokshi Jhora and Bangla Khola were added but this could not cope up with the rapid rise of population as a result of which the hue and cry for drinking water specially during dry period (December to May) has remained a constant feature for the last two decades or so. But the crisis during the last few years or so has reached its peak due to the drastic fall in the volume of water at natural springs of catchment area due to massive illegal felling of trees. The present population of Darjeeling town is more than 1.18 lakh and with the opening of schools, colleges and the beginning of tourist season which fall with dry period (March to May) the total population is added by another 40 to 50 thousand of floating population resulting to a total population of about 1.68 lakhs for which water has to be provided.

9.3. Issues of Water Scarcity in Darjeeling Town

Now days, it has become a common known fact to the people of Darjeeling from every walks of life that the Darjeeling Town is supplied with drinking water from twin Senchel lakes (South Lake with capacity of 13 million gallons built in 1910 & North Lake with capacity of 20 million gallons built in 1932) having its source from 26 Nos of perennial springs in the Senchel Catchments Area, constructed by Thos Kenay; the first engineer of Darjeeling Municipality, which is five and half miles away from Darjeeling Town.

The total capacity of these two lakes is 33 million gallons. Water filtration is done through Gravity Pressure Filters situated at Jorbunglow Filter House and from there water is further supplied through large conduits to the reservoirs built at St. Paul having capacity of 2,35,812 gallons and at Rockville having capacity of 1,14,000 gallons. The whole distribution network is run by operating Valves not only near the main tank at St. Paul and Rockville but also at many places in town. In total there are more than 90 such Valves scattered all over the town. Many areas in the town will not get water if these Valves are not opened in a synchronized manner by the different Valves man at different places. Thus, this area will depend on the whims of the Valves man and human errors which naturally lead to corruption to some extend.

Sources of water supply in the hills are mainly the water springs; these springs directly depend upon the topography and its rainfall. Therefore, it is very much essential to preserve the catchments area, which feeds such springs. The proper preservation of the catchments area is important. Now due to indiscriminate deforestation and illegal construction near the catchments area, out of 26 springs only 14 springs are continue to exist.

During rainy season the collection of water at Senchal Catchments area becomes sufficient from 8 to 10 springs, the rest of the springs have to cut off due to limited capacity of reservoirs at Senchal lakes Besides these two lakes, another third lake with capacity of 15 million gallons was constructed by Government of west Bengal in the year 1978 at Singdhap, but due to poor quality of the reservoir and leakage, it is almost dead lake. Considering the need of the growing population with exploding geometrical ratio and the flow of tourists, it is urgently necessary to construct more additions reservoirs at Senchal area.

Besides the construction of additional large reservoir at Senchal area, there is also need for the construction of various sizes of subsidiary tanks in each and every village and ward as per the availability of space, if this initiative is not taken in proper time then there will be no space left unoccupied for this purpose in the near future.

9.4. Challenges of Water Scarcity in Darjeeling Town

Darjeeling municipal town is still suffering by the heavy storage of water supply and the per capita availability of water in the town. Only 50 per cent of the municipal households are connected to the municipal water supply. The historic water problem has gone from bad to worse because of widening gap between supply and demand. Water supply figures definitely indicate the mushrooming of such water shops in near future. The average demand for water for the Darjeeling town is 15 lakh gallons but the availability is 5 Lakh gallons. This amounts to a per capita water supply of 22 liters whilst the national standard in 70 litres per day. That too there is no regular supply of water. Some municipal areas receive water once a week. The more fortunate receive it once in four days. The paradox- Darjeeling is a place with one of the highest rate of rainfall in the country. In Darjeeling most of the people don't have huge water storage tanks, so buying tanker and handcart loads often pose storage problems.

Shortage of drinking water in Darjeeling Town has been felt for the past thirty (50) years or more. In order to solve the problem schemes like Sindhap Lake, Bangla Khola, Initial scheme for Rambi water tapping of springs at different locations were carried out in the past, but the problem remained unsolved. Finally comprehensive Rambi water supply scheme was carried out in the past with an improvement in the total yield @1.5 lakh gallons per day but the 2nd phase of the scheme was abandoned on the report of PHE (Public Health Engineering) although it was sanctioned.

10. CONCLUDING REMARKS

There is adequate water resource available in Darjeeling to meet the everyday demand of people. Darjeeling is blessed with a high rainfall. The annual rainfall is among the highest in India. Due to the

mountainous terrain, ground water gushes out in the form of springs. The water resource of Darjeeling has been severely stressed and strained in the last decade by rapid urbanisation, deforestation, drying-up of sources of water and, last but not the least, a huge amount of construction activity taking place at a hectic place. Darjeeling town, being an important tourist spot and having several renowned educational institutions and tea industry, is becoming over populated day by day. Density of population has increased by 46.7% from 1991 to 2001 and 10.8% from 2001 to 2011 and is still increasing and consequently demand of water is increasing. At present a total of 2,18,000 MG of water is being stored from jhoras in 3 lakes and is supplied to the town. There is a shortage of supply of 0.30 MLD (Million Litres per day) in non-lean period and during lean period it becomes 6.31 MLD. This shortfall could be met by construction of more reservoirs, but the Senchal ridge is not favourable for construction of such reservoirs. Considering the normal annual rainfall as 2973 mm, net annual rainwater available in Darjeeling town is 19 MCM (Million Cubic Meter), which will spend only 16.5 % to meet up the entire annual demand of water of Darjeeling town. Now, even in the rainy season people get water once in three days or four days only that also for a very limited period. But in the dry period i.e. in March, April and May water is supplied at an interval of six to thirteen/fourteen days. In spite of the presence of sufficient resources to sustain the need of the people, the authorities are unable to harness these resources to make them adequate for drinking purpose. Long-term proper planning is thus of extreme importance in the hills for the proper management and maintenance of the available water resources in a sustainable manner.

11. SUGGESTIONS

- In hilly terrain of Darjeeling area, water supply is mainly based on spring water. Considering the water crisis during summer months, rainwater and spring water conservation at proper locations in different types of reservoirs are to be encouraged and is to be utilized with proper treatment.
- There is need of improvement for old and complicated water distribution system to make it a uniform supply system. For this, realignment of the main supply line with necessary changes in the distribution system is needed under the supervision of an expert engineer.
- An alternative conduit from Khong Khola to Senchal lake covering distance of 5 kilometers should be constructed, so that there will be no problem to repair the old conduit.
- The leakage of the reservoir specially in the Rockville Tank and main distribution lines are required to be repaired as soon as possible which can save water at least @15 to 20 % of total water demand.
- Houses have come up on existing pipelines; hence, identifying illegal connections /leakages are difficult. This problem can be solved by laying alternative pipelines at such locations. Wherever, the new pipeline is to be laid, it should preferably be laid with sufficient soil cover from top to avoid illegal tapping
- To ensure the supply of pure drinking water to the citizen of the Town and the tourists, all the old and worn out water pipes of the private lines should be removed from the drain and the Jhora, because most of the people of the town are compelled to drink contaminated water because most of the pipes are passing through drain and jhora.
- The local authority should take the help of the local NGOs to detect the number of households unknowingly drinking contaminated water due to laying of their pipe line under the drain.
- Hence some repair and renovation work has to be implemented to improve the present water distribution system in and around Darjeeling Municipal Area.

Rainwater harvesting should be encouraged at the community levels with proper incentives. The success story of the St Josephs College Girls' Hostel in the Singamari Area needs to be replicated in as many areas as possible.

REFERENCES

[1] A Profile of Darjeeling Municipality (2012), *A Report of Waterworks Department*, Darjeeling Municipality, Darjeeling.

[2] *An Annual Report of Darjeeling Municipality* (2010), Darjeeling Municipality, Darjeeling.

[3] Aktar, N & Sultana, C. (2014); "*Trends and Pattern of Urbanization in West Bengal*, Pratidhwani the Echo, Volume-III, Issue-II, pp. 89-101.

[4] Bhutia, S. (2015); "*Urban Growth & Its Implication on Tourism in the Queen of Hills: A Case Study of Darjeeling Town*", Parimarsh, A National Interdisciplinary Research Journal Dedicated to Global Dialogue, published by Parishkar College of Global Excellence, Jaipur, Rajasthan, Year 1, Volume 2, pp.. 49-65.

[5] Bhutia, S. (2015); "*A Spatio-Temporal Study on Urbanization in the Darjeeling Himalaya: A Demographic Perspective*", IOSR Journal of Humanities and Social Science (IOSR-JHSS), Volume 20, Issue 4, Ver., pp. 10-18.

[6] Biswas, A. K., (1985), *Ancient Urban Water Supply Systems*, *Geo Journal*, Vol. 11, No. 3, pp. 207-213.

[7] Borah, R. (2013), *Status of Drinking Water in Guwahati City*, M. Phil. Dissertation, Department of Geography, Gauhati University.

[8] Census of India (1981); *West Bengal, District Census Handbook*, Darjiling District, Series – 23, Part XIII A and B.

[9] Census of India (2001); *West Bengal, Primary Census Abstract*, Darjiling District, Vol.- I, Table A5, A6 and A7.

[10] Census of India (2001); *West Bengal, Primary Census Abstract*, Darjiling District, Vol. - II, Table A8 and A9.

[11] Census of India (2011); *West Bengal, Primary Census Abstract*, Darjiling District, (Available in CD Rom).

[12] Government of West Bengal, West Bengal State Action Plan on Climate Change Report, April, 2012, pp. 165-205.

[13] Lepcha, Neelee K. C. (2013), *Problems And Prospects Of Water Resource of Kurseong Municipality, Darjeeling District, West Bengal*", Science Park Research Journal, Vol-1, Issue-19, 28, pp 1-11.

[14] O'malley, L.S.S. (1999); "*Bengal District Gazetteers*", Darjeeling, Logos Press, New Delhi.

[15] Panwarl, Ar. Manoj & Antil, Sunil (2015); "*Issues, Challenges and Prospects of Water Supply in Urban India*", IOSR Journal of Humanities And Social Science (IOSR-JHSS), Volume 20, Issue 5, Ver. II, pp. 68-73.

[16] Umamani, K. S. & Manasi, S. (2013); *"Rainwater Harvesting Initiative in Bangalore City: Problems and Prospects*", Working Paper, The Institute for Social and Economic Change, Bangalore, 2013, pp. 1-20.

WORKS CITED FROM NEWSPAPER & MAGAZINE

(i) *Balasun gesture a farce*: Civic Chief-Chief Minister to commission project today, water to hill residents in 2015 by Vivek Chhetri, The Telegraph, Thursday, July 17, 2014.

(ii) *Centre funds Darjeeling water supply rejig*, The Telegraph, Tuesday, April 26, 2016.

(iii) *Hill first step on water supply cure* by by Vivek Chhetri, The Telegraph, Thursday, July 4, 2013.

(iv) *Rs. 170 cr grants to solve Hills water crisis*, The Times of India, Kolkata, Feb 22, 2014.

(v) *Water crisis in No solution to water problem in Darjeeling hits a new low* by Nirmalya Banerjee, The Times of India, Dec 7, 2012.

(vi) *Water Problem in Darjeeling* by Bhotoo Singh Chhetri, Darjeeling Times, August 27, 2006.

(vii) *Water crisis in Darjeeling* by Amitava Banerjee, Hindustan Times, April 05, 2007.

WORKS CITED FROM INTERNET

(i) About Darjeeling: Retrieved on 11/11/2017 from http://www.darjeelingtourism.com/ darj_ 0000fd.htm

(ii) An Analysis of the Problem of Water Supply in the Himalayan Town of Darjeeling and its Solution by A. K. Bhattacharya, A. Sharma & K. Srinivas, Piyush Kumar Singh: Retrived on

11/11/1017 from http://www.academia.edu/25644901/An_Analysis_of_the_Problem of_ Water_Supply_in_the_Himalayan_Town_of_Darjeeling_and_its_Solution

(iii) Darjeeling town: Retrieved on 11/11/2017 from http://hhr.in/Darjeeling.html

(iv) Darjeeling and its daily struggle for water, Merinews, 29th March 2013: Retrieved on 11/11/2017 from http://www.merinews.com/article/darjeeling-and-its-dailystruggleforwater/15883437.shtml &cp

(v) Scarcity of Water in Darjeeling Municipal Area: Retrieved on 11/11/2017 from http://dm. gensoftindia.co.in/waterworks/Scarcity-of-Water.aspx

(vi) Water shortage hurting Darjeeling tourism, life by Rajdeep Datta Roy: Retrieved on 11/11/2017 from http://www.livemint.com/Politics/n6Aom6oe5HSuazkBTHPrOI/ Water-shortage-hurting-Darjeeling-tourism-life.html

(vii) Water woes in Darjeeling: Retrieved on 11/11/2017 from https://www.darjeeling-tourism.com/darj_00011d.htm

(viii) Welcome to Darjeeling: Retrieved on 11/11/2017 from http://wbnorthbengaldev.gov.in /HtmlPage/darjeeling.aspx

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