2321-8045 Science Park Research Journal Vol-1, Issue-19, 28th November 2013

PRIMARY ARTICLE

# Problems And Prospects Of Water Resource Of Kurseong Municipality, Darjeeling District, West Bengal

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## ABSTRACT

Water is an essential source to life and is important to understand that urban water management and its conservation play a critical role in enabling a sustainable urban environment. Having a secure supply of clean water to a town is of fundamental importance as it is known to all, the multi-interest utilization of water resources everywhere. 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 especially in Darjeeling hills which unlike plains lack the advantage of alternative sources. The faulty anthropogenic activities have vitiated the water resources in the region. The present paper attempts to assess the water supply in Kurseong town, to probe into the causes of water scarcity, to identify the associated problems and to suggest alternative measures.

**Keywords:** Water scarcity, Urbanisation, deforestation, Sustainable Development.

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The Article Is Published On November 2013 Issue & Available At www.scienceparks.in

DOI: 10.9780/23218045/1192013/45

## 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.

## 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 (Table.1), 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 the region.

Consequently, water shortage becomes a severe crisis in Kurseong 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 Kurseong go dry.

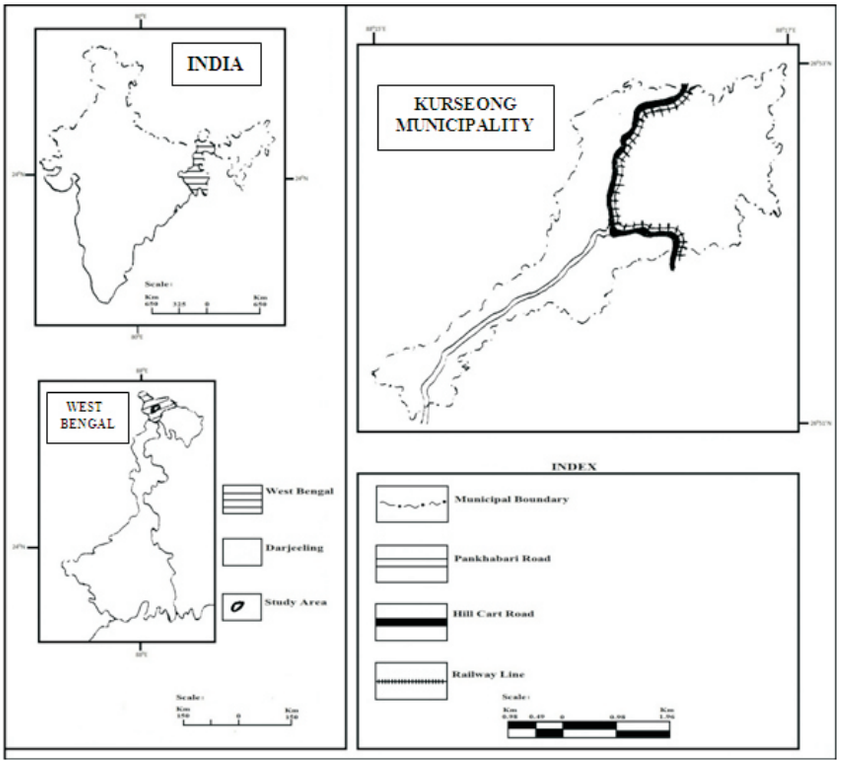
As widespread water scarcity and misuse of water pose a serious and growing threat to sustainable development and protection of the environment, immediate and effective action for management of water resources with a holistic approach is of foremost importance and therefore demands an integrated water resource planning and management for an adequate and comfortable supply to the residents of Kurseong town.

## The Study Area

Kurseong town, the administrative headquarter of Kurseong subdivision is situated at 26° 51' 42"N to 26° 53' 36"N latitude and 88° 15'12" E to 88° 17'32" E longitudes in Darjeeling district of West Bengal. Kurseong was constituted as a Municipality in 1879. Before 1879, it was under the supervision of Darjeeling Municipality which was constituted in 1850. Later in 1880 this tiny hamlet developed as a tourist destination for colonial authorities and a preferred place for a sanatorium, where the diseased would recuperate. Kurseong Municipality has an area of 7. 5 0 sq.km and it consists of 20 wards.

The name of the town is opined to have been derived from the Lepcha word "Kurson-rip" meaning the small White Orchid which grows abundantly in and around Kurseong, thus Kurseong meaning "The Land of White Orchids."

**Location map of the Study Area**




## Objectives

The main objectives of this paper are to assess the water supply in the town, to probe into the causes of water scarcity, to identify the associated problems and to suggest alternative measures.

## Data Base and Methodology

The study is based entirely on the secondary data collected from census publication, covering the period from 1911 to 2011 and various other government institutions.Future population growth has been calculated by taking out the mean estimate of Arithmetic Progression, Geometric Progression and Time Series Analysis by

Least Square Method.

**Water supply: Origin and character**

Kurseong municipality was formed in 1879. According to a report by the then Health Commissioner of Bengal, the total population of the municipality at that time was 2836 consisting of 1707 male and 1039 female. The civic amenities and the infrastructural facilities were planned and installed accordingly. In recent years these infrastructure and civic amenities are supporting a population of 42346 (2011 census provisional).

The Kurseong water works began operating in 1913. At present the storage and augmentation of water is the responsibility of the P.H.E. Department. The water supply to the Central Reservoirs & Service Reservoirs from the catchments situated at various locations is maintained by the P.H.E. Department and the distribution from the service reservoir to the different parts of the municipality area is maintained by the municipality.

In spite of all these efforts by the P.H.E. department and the municipality to enhance the water supply, huge gap exists between the demand and supply of water in the study area. The U.N. recommends a standard of 20 gallons per head per day. Considering this fact the total demand for Kurseong town was estimated at 840000 gallons for a population of 42000 (2001 census l) by the municipality. In contrary to this, the people are getting only 88868 gallons per day in the lean months (Annual Administrative Report, 2008-09). Thus there is a dreadful shortage of about 7, 51,132 gallons per day. Distribution of water by the municipality to the public through tankers and trucks is a common scene during the dry seasons owing to acute shortage of water. The scenario will become even more acute, leading to an interminable water crisis in Kurseong in future.

Due to reckless deforestation in the catchment areas located within 20km from the town, the water supply to the town is being adversely affected (Table.1). The State Forestry Department controls, monitors and enforces the issues regarding deforestation. However, in the process of avoiding any conflicts with the local population the department seems to be in compulsion and is unable to execute its duty effectively. The main feeder conduit pipes from the source to the reservoir were laid during British regime and thus are in dilapidated

Table.1
Total trees removal and Forest Encroachment

| Sub-divisional headquarter | Total tree removal (Area in hectares) | | Forest encroachment(Area in hectares) | |
|---|---|---|---|---|
| Kurseong | 2002-2003 | 494.95 | 2002 | 85.69 |
| | 2003-2004 | 1180.65 | | |
| | 2004-2005 | 535.50 | | |

Source: D.F.O Darjeeling (Working Plan – 105)

conditions resulting in innumerous leakages and consequently inadequate supply of water to the reservoirs. Uncontrolled illegal tapping and water losses in the delivery and distribution networks further aggravate the problem. In addition, the water supply is disrupted by frequent landslides. Due to the financial deficiency, the P.H.E. Dept. has not been able to do the repair work and maintain these conduits.

The capacities of the existing reservoirs are inadequate to cater to the present demand due to unprecedented population growth of the town. The trend of urban concentration reveals that the population of Kurseong town increased more than 3 times from 11719 in 1951 to 42,346 in 2011. Some of the Municipal wards are not fully covered with proper supply of potable water (Annual Administrative Report 2008-09). Even the water distribution is uneven across the municipal area with some wards having a limited water supply than the others. Moreover, many new housing complexes have come up in the municipal area, which will definitely require an adequate water supply. Owing to supply of water in alternative days during the lean months water is brought from the jhoras in trucks, jeeps, water tankers for supplies to households, hotels, restaurants and commercial establishments privately. Kurseong town has no provisions of specified water reservoirs for fire fighting in order to remain prepared for any fire accidents like the one that devastated the town in 1986.

The water usage metering system is absent in Kurseong municipality. The current municipal estimates are based on governmental recommendations of daily consumption at the rate of 135 litres/capita (Prasad S., Water Management Study in Kurseong, 2010-2011). In the absence of such system at any point of the entire water network, any data on reliable estimates are unavailable, which is a major obstruction on the way of any future planning. There is no Waste Water Treatment Plant in operation at present. Owing to insufficient budget from the government and unsatisfying existing tax collection system, the municipality finds it difficult to provide and maintain a satisfying water functioning system.

## Estimation of water resources of Kurseong town

Water reserves in Kurseong town are fed by a number of perennial and semi-perennial natural springs located in and around Kurseong. Consideration of all these resources is essential for correct estimation of water resources in town (Table.2) (Fig.1).

Table.2
Estimation of water resources of Kurseong town (2010-2011)

| Months | Rainfall in mm | Temperature in °c | Evaporation Loss (mm) | Evaporation Loss as % of rainfall | Run-off in mm | Run-off as % of rainfall |
|---|---|---|---|---|---|---|
| January | 5.2 | 7.9 | 1.3 | 25.0 | 3.9 | 75.0 |
| February | 9.0 | 10.95 | 2.0 | 22.22 | 7.0 | 77.77 |
| March | 17.8 | 12.85 | 3.0 | 16.85 | 14.8 | 83.15 |
| April | 49.1 | 14.8 | 3.2 | 6.52 | 45.9 | 93.48 |
| May | 15.6 | 16.65 | 2.7 | 17.31 | 12.9 | 82.69 |
| June | 1021.2 | 18.65 | 4.4 | 0.43 | 1016.8 | 99.57 |
| July | 1208.2 | 20.3 | 5.5 | 0.46 | 1202.7 | 99.54 |
| August | 1280.5 | 19.35 | 4.8 | 0.37 | 1275.7 | 99.63 |
| September | 536.8 | 18.25 | 2.2 | 0.41 | 534.6 | 99.59 |
| October | 74.3 | 16.85 | 2.8 | 3.77 | 71.5 | 96.23 |
| November | 0.0 | 14.5 | 1.5 | - | -1.5 | - |
| December | 0.0 | 11.9 | 2.0 | - | -2.0 | - |
| | ∑ 4217.7 | ∑ 15.25 | ∑ 35.4 | ∑.84 | ∑ 4182.3 | ∑99.16 |

Source: Darjeeling Tea Research Centre

Rainfall and Runoff, Kurseong town (2010-2011)

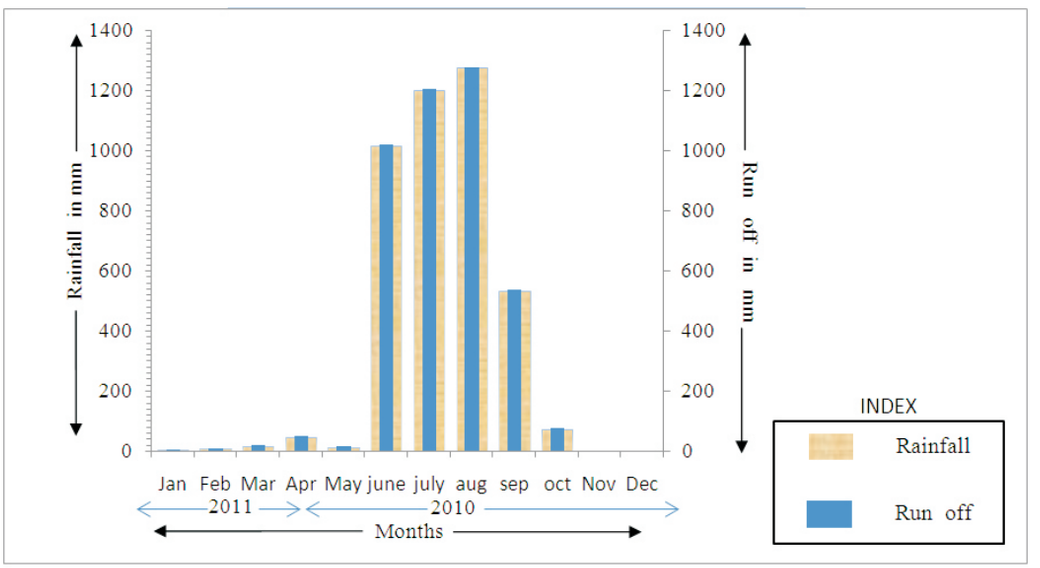



Fig.2

It is evident from the above table that the total average runoff of Kurseong town is about 4182.3 mm and the total geographical area is 7.50 sq. km. Thus the availability of total water is 557.64 mm3/km2 in Kurseong town. Although the available amount is supposed to be sufficient for the needs of the residents the problems are manifold:

i)The water scarcity is strongly felt during the lean period i.e. from November to May every year.

ii)Being age old reservoirs their existing capacity are inadequate to cater to the present demand. The feeder conduit lines from the Catchments Source to the Central Reservoirs & to the Service Reservoirs are obsolete. The supply pipes are in decaying condition. During the lean months, often the distribution of water has to be made to the public through tankers and trucks.

iii)The existing faulty distribution system due to uncontrolled illegal tapping and water losses in the delivery and distribution networks.

iv)Lack of extensive practice of rain harvesting techniques and

v)An additional floating population of 3000 as students in residential schools.

## Existing water supply system

Kurseong town has quite a number of perennial and semi perennial sources of water in the form of hilly streams. The water supply system of the town involves tapping of 10 natural spring sources in the catchment region located in the dense forest area of distances ranging from 02 to 20 K.M. (Table.3). These streams are impounded with small setting tanks for storing water from where water is directed first to the Central Reservoirs through G.I. pipe lines of various sizes after preliminary sedimentation of filtration and then to the Service Reservoirs located at different convenient places of the municipality through the feeder conduit lines. The distribution is then made to the residents of various wards with a network of connection pipes of approximately 2" diameters (Table.5). Kurseong Municipality has neither tube wells nor any pumping stations. Due to the naturally sloped character of the area the gravity flow system has been adopted for channelizing and distribution of water to different places.

Table.3
Sources of water for feeding Central Water Reservoir

| Sl. No. | Name of the Perennial Source | Diameter of Feeder Lines | Name of the Feeding Reservoirs | Distance from Reservoirs |
|---|---|---|---|---|
| 01. | Dharay Khola (near Bagora) | 80 mm / 100mm | Dow Hill Central Reservoir (at Durpin) | 12 KM |
| 02. | Babu Khola (near Khundrukay) | 150 mm | Dow Hill Central Reservoir (at Durpin) | 12 KM |
| 03. | Panigaira Khola (near Khundrukay) | 150 mm | Dow Hill Central Reservoir (at Durpin) | --- |
| 04. | Pahwa Khola (near Deorali) | 150 mm/ 100 mm | Central Water Service Reservoir (at Victoria) | 7.50 KM |
| 05. | Chitray Khola (near Chitray Bustay) | 50 mm | Central Water Reservoir (at Victoria) | 5 KM |
| 06. | Aringalay Khola (near Dilaram) | 80 mm | St. Helen's Service Reservoir | 6.50 KM |
| 07. | Sepoydhura Khola (near Sepoydhura) | 150 mm / 100 mm | St. Helen's Service Reservoir | 4.50 KM |
| 08. | Baluwakhani Khola (8th Mile near Sonada) | 100 mm/ 80 mm | Eagle's Craig Service Reservoir | 16.10 KM |
| 09. | Thothay Khola (near Tung) | 80 mm | Eagle's Craig Service Reservoir | 10.40 KM |
| 10. | Whistle Khola (near St. Mary's Hill) | 50 mm | Service Reservoir above Church | 1.50 KM |

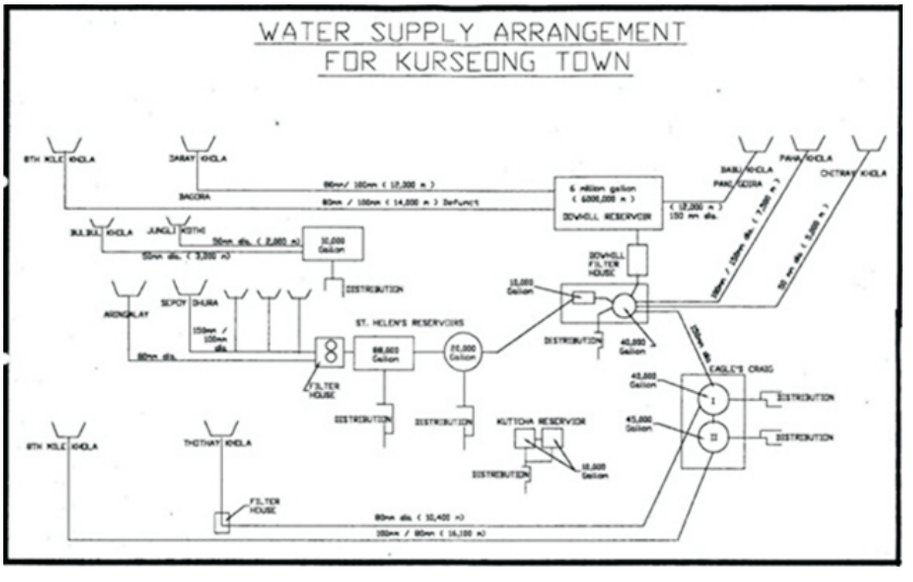
Source: Municipality office, Kurseong

Table.4
Storage facilities and capacities of the storage tanks

| Sl.No. | Reservoir | Capacity | Type |
|---|---|---|---|
| 1. | R.C. Storage Tank at Dow Hill Forest Area (Durpin) | 4500000 gallons | Rectangular |
| 2. | Central Water Reservoir near Victoria School (with Filter and Chlorination Devices) | R.C.C. Tank<br>45,000 gallons<br>b) 20,000 gallons | Circular<br>Rectangular |
| 3. | Central Water Reservoir near St. Helen's Convent(with Filter and Chlorination Devices) | R.C.C. Tank<br>a) 88,000 gallons<br>b) 20,000 gallons | Rectangular<br>Circular |
| 4. | Central Water Reservoir at Eagles Craig(With Filter and Chlorination Devices) | R.C.C. Tank<br>a) 45,000 gallons<br>b) 50,000 gallons | Circular<br>Circular |
| 5. | Central Reservoir near Municipality office for tapping unfiltered water, water from various | R.C.C. Tank<br>20,000 gallons. (Springs raw water for use in washing).20,000 gallons. (lavindering toilets and fire hydrants).<br>b) 20,000 gallons | Rectangular<br>Rectangular<br>Rectangular |
| 6. | Central Water Reservoir at Dowhill near Post Office (without filter and Chlorination devices). | R.C.C. Tank<br>10,000 gallons | Rectangular |

Source: Municipality office, Kurseong

In spite of the above mentioned reservoirs with a total capacity of 33, 8,000 gallons (Fig.2) water scarcity is strongly felt during the lean period particularly from November to May every year. Thus the situation becomes ironical as excess of water is available during the Monsoons when the local people can harvest the rain water and augment their needs while the situation is contrary to this during the lean months.




Source: Municipality Office, Kurseong

Fig.3

**Total availability of water**

The total storage facility and the total availability of water during the summer months of Kurseong town have been estimated by the municipality as follows (Table.6):

Table.6
Availability of water during lean period (February to Mid of June)

| Total Storage capacity of the Service Reservoirs (in litres) | Availability of water during lean period from the Catchments Source (in litres) | Additional supply of water from the Central Water Reservoir at Durpin (in litres) | Total availability of water during the lean period (in litres) | Average shortage of water during the lean period (in litres) |
|---|---|---|---|---|
| 14,50,000 (318955.41003 gallons) | 1,54,000 (33875.26424 gallons) | 2,50,000 (54992.31207 gallons) | 4,04,000 (88867.57631 gallons) | 10,46,000 (230087.83372 gallons) |

Source: Municipality office, Kurseong

It is clear from the above table that only about 14.53 % of the actual water requirements is being met by the Municipal Water Supply System. Therefore a wide gap exists between the demand and supply of water in Kurseong town, especially during the lean months.

**Estimated total water requirements**

The present population of Kurseong town is about 42346 (2011, provisional) with another 3000 (approximately) as floating population in the form of students in residential schools and college, thus making a total population of about 45346. Water has to be provided for this number of population even during the crucial four dry months i.e. from February to May. The approximate estimate of demand, for a minimum population of about 45300 would be as follows (Table.7) (Fig.3):

Table.7
Estimated water requirements for Kurseong town

| | | |
|---|---|---|
| 1. | Domestic demand (taking a minimum of 10 gallons/head/day as against 30 gallons/head/day as per the Indian standard) | 453000 gallons |
| 2 | Industrial/Commercial Demand (10% of total) | 45300 |
| 3. | Public Utility (5% of total) | 22650 |
| 4. | Fire Demand | - |
| 5. | Water required to compensate losses in leakage, water theft etc. (20 % of total) | 90600 |
| | Total gallons per day | 611550 gallons |

Estimated water requirements for Kurseong town

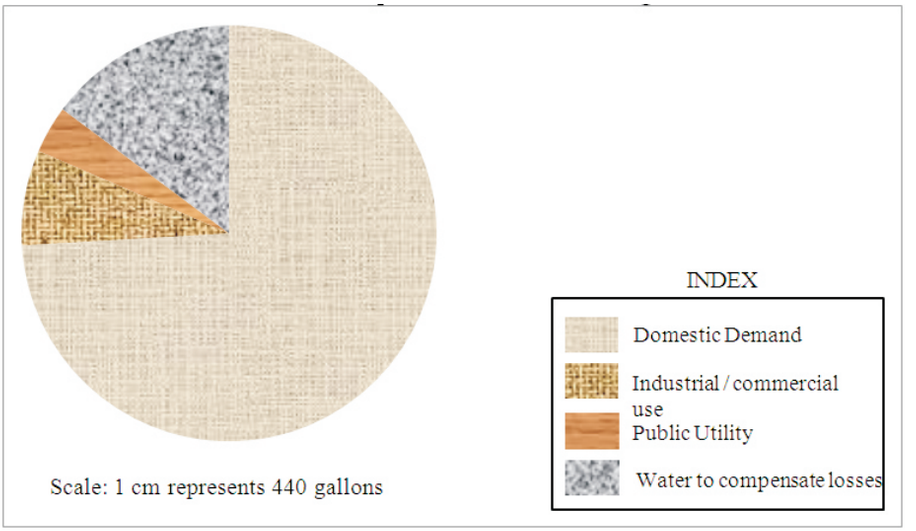



Fig.4

The approximate future population projection and water requirements of Kurseong municipality have been estimated (Table.8) which reveals that huge gap is likely to exist between the demand and supply of water resulting in interminable water crisis in future (Fig.4).

Table.8
Future population growth and water supply projection
(Kurseong municipality)

| | | Projected population | | |
|---|---|---|---|---|
| | Year | 2011 | 2021 | 2031 |
| | Actual population + floating population | 45346 | 52612 | 62616 |
| | Future water requirements (in gallons) | | | |
| 1. | Domestic demand | 453000 | 526000 | 626000 |
| 2. | Industrial/ Commercial Demand | 45300 | 52600 | 62600 |
| 3. | Public Utility | 22650 | 26300 | 31300 |
| 4. | Fire Demand | - | - | - |
| 5. | Water required to compensate losses in leakage, water theft etc. | 90600 | 105200 | 125200 |
| | Total gallons per day | 6115500 | 710100 | 845100 |

Estimated population and water requirements

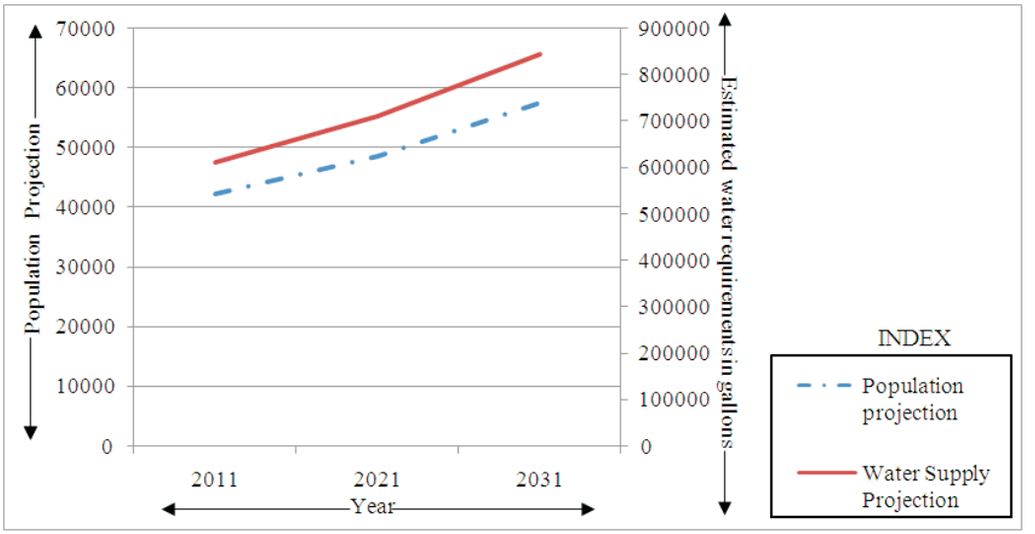



Fig.5

## Mitigation Measures

The following measures are recommended for improvement of water supply system in Kurseong town under present circumstances.

Short term measures:

- Immediate restoration of catchment areas with large scale afforestation programmes.
- Identification and protection of potential sources of freshwater supply.
- Complete stoppage of felling of trees in the catchment areas which are situated within the forest jurisdiction.
- Replacement of obsolete pipes with new ones and laying new water supply lines with modern technology.
- Construction of new water reservoirs at different suitable places keeping in view the geology of the area.
- Renovation of the existing water reservoirs and improvement of water distribution system for providing an efficient service.
- Regular examination and inspection of water reservoirs and the supplying feeder conduit lines to avoid profuse leakages. Domestic supply systems often lose 50 percent of their water to leaks (Bahri A., 2012). Singapore now has one of the world's lowest nonrevenue water rates where a sophisticated system detects leaks in pipes. Similarly JUSCO, Jamshedpur Utilities and Services Company Limited has implemented monitoring system in its supply areas where leakages are monitored daily and reported weekly.
- Reusing and recycling of water on an extensive scale is the best solution in order to multiply water supply, enhance self-sufficiency in water and to achieve long-term sustainability.
- Involving public participation including youth, women, indigenous people and local communities in water management policy-making and decision-making. Strengthening education and training programmes for the staff at all levels. Small municipalities like Kurseong lacking in internal budgetary resources extensively requires skilled staff with knowledge potentiality.
- Maximum utilization of existing comes, through maintenance, rehabilitation and optimum operation.
- Programmes involving the student community in various eco-restoration programmes, media campaigns, organizing water theme rallies on World Water Day (22nd March), quiz and science shows, seminars and workshops on water in schools and imparting education to the public on water conservation, management and rainwater harvesting can grow into an effective mass movement.
- The damages to pipes from landslides can be prevented by burying them underground though it is costly and requires regular inspection.

**Long term measures:**

- Preparation of master plan for water supply management keeping in view the sustainable and rational utilization, protection, conservation and management of water resources based on community needs.
- Exploration of all natural springs located nearby for elimination of water crisis.
- Implementation of rain water harvesting system on an extensive scale in various locations like schools, residential colonies, and housing complexes for providing adequate water supply. It should be made mandatory to include the provision of rainwater harvesting arrangements in building plans like in Jamshedpur.
- Segregation in supplies of potable water and water for other uses as quantity and quality of water determines the nature of its utilization.
- Preparation of future plans and schemes to cope with the situation, to eliminate the crisis and to augment the supply.
- Adoption of wastage minimization measures as well as changes in user behavior like mandatory installation of water-saving devices in nondomestic premises and residential apartments like in Singapore and Zaragoza in Spain.
- Pumping of water from the Balason River to the water reservoirs.
- Introduction of water usage metering system as a part of the municipal water network to know the actual water consumption/capita and to ensure a fair and transparent system which will aid in the planning process like in Bangkok and Singapore.
- Strict enforcement of laws against water misuse and strengthening in the governance, administration and enforcement of rules and regulations in illegal connections.
- Optimization of the budgetary aspects on public utility services to maintain its service levels. The existing unsatisfying tax collection on utility services by Kurseong municipality can be improved by imposing stringent penalties for late payments and offering convenient payment channels like via internet, telephone, mobile phones, post offices and banks.

**Conclusion**

In recognising water as an essential source to life, it is important to understand that urban water management and its conservation play a critical role in enabling a sustainable urban environment. The Indo-Sweedish project, the collaboration shared by ARTAMUS, an international Sweedish consultancy network, IIIEE, International Institute of Industrial Environmental Economics, Lund University and Kurseong municipality is definitely an assuring and brilliant step on the part of the municipality though due to political unrest in the hills, the project is unable to proceed. The urban water demand is expected to grow even with the implementation of aggressive water conservation programmes due to continuous population increase and the multiplication of functions and services. According to Lacey and Heywood (2010) successful water management include multiple facets like planning, designing, constructing, operating and maintaining the infrastructure associated with water supply. A big challenge, therefore, lies before the Kurseong municipality and the local people to take up various water issues and obtain reliable, clean and efficient water supply system. However, it is an inconvenient truth that until and unless the people realize the impact of their selfish imprudent act and there is an effective mass movement involving each individual, the possible dream of handling this crisis intelligently, if not solving permanently might be lost forever.

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