

**SUSTAINABLE URBAN WATER MANAGEMENT IN
DARJEELING**

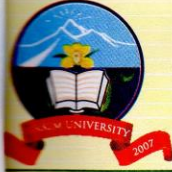
*Dissertation Submitted to Sikkim University in Partial Fulfillment of the
Requirement for the Award of the Degree of*

MASTER OF PHILOSOPHY

SUVECHHA GHATANI



**DEPARTMENT OF GEOGRAPHY
SCHOOL OF HUMAN SCIENCES
SIKKIM UNIVERSITY
GANGTOK- 737102
2015**



DEPARTMENT OF GEOGRAPHY SIKKIM UNIVERSITY

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Date: ...27..Feb 2015

DECLARATION

I, Suvechha Ghatani, hereby declare that the subject matter of this dissertation entitled “Sustainable Urban Water Management in Darjeeling” is the record of work done by me, that the content of this did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and the dissertation has not been submitted by me to any other University /Institute.

This is being submitted in the partial fulfilment of the requirements of the degree of **Master of Philosophy** in the Department of Geography, School of Human Sciences, Sikkim University.

Suvechha Ghatani
27.02.15

(Suvechha Ghatani)

Roll No: 13MPGP05

Registration No: 11504471

We recommend that this dissertation be placed before the examiners for evaluation.

Rafiul Ahmed
27/02/2015

(Dr. Rafiul Ahmed)

Head of the Department

अध्यक्ष
Head
भूगोल विभाग
Department of Geography
सिक्किम विश्वविद्यालय
Sikkim University

Vimal Khawas

(Dr. Vimal Khawas)

Vimal Khawas PhD (JNU)

Supervisor
Assistant Professor

Dept. of Geography &

Natural Resources Management

SIKKIM UNIVERSITY (A Central University)



6th Mile, Samdur, PO Tadong 737102, Gangtok, Sikkim, India.

Phone: + 91- 3592-251137(O)

www.sikkimuniversity.ac.in

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ACRONYMS

GWP	Global Water Partnership
IUCN	International Union for Conservation of Nature and Natural Resources
WCED	World Commission on Environment and Development
PHED	Public Health Engineering Department
PWD	Public Works Department
CI	Cast Iron
MWSI	Municipal Water Supply Infrastructure
MWS	Municipal Water Supply
LPCD	Liters Per Capita per Day
GDNS	Gorkha Dukha Niwarak Samity
CBO	Community Based Organizations
MLD	Millions of Liters per Day
MG	Million Gallons
PSPs	Public Stand Posts
ILCS	Integrated Low Cost Sanitation Schemes
ISMT	Integrated Development of Small and Medium Towns

CHAPTER 1

INTRODUCTION

1.1. Introduction

Water is the primary resource for existence of life on the earth and a basic necessity which plays a very important role in our day to day life. All the dimensions of security like food security, economic security and human security at large depends on water. Thus, the crucial importance of water in every part of the world makes it an essential component for international, national and local security. Water is one of the most widespread substances covering about 70 percent of the earth surface. The total volume of water available on the earth is about 1,360,000,000 km³ but, 97 percent of the available water is saline and 2 percent of it is locked in ice caps and glaciers, therefore only 1 percent of the available water is portable (Postel, 1992). The availability of fresh water is very limited. Further, it is not evenly distributed leaving many areas of the world suffering from water stress and water scarcity. It therefore highlights the need to manage the freshwater resource and rationalize their use. Sustainable use of water is consequently regarded as a basic necessity in order to conserve water for future generations.

The UN Water Conference in 1977 agreed that "all peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs" and access to safe water has therefore become a kind of human right (Kundzewicz, 1997). Yet, large number of human being still lack clean and safe water. Water resource is under severe stress across the world today. According to Falkenmark and Lindh (1993) 1.2 billion people or almost one fifth of the world's population lives in the area of physical water scarcity, while almost one quarter of the world's population face economic water shortage and it is estimated that by 2025, 800 million people will be living in the region with absolute water scarcity and two third of the world's population could be under severe stress condition. It can thus be argued that access to clean and safe water in

sufficient quality and quantity is one of the most serious challenges faced in the 21st century.

Rapid population growth, increasing urbanization, industrial development, expansion of irrigated agriculture, and rise in the standard of living are the major factors that has affected the use and distribution of water resources (Biswas, 2006). Today the proportion of world's population living in urban area has suppressed the population living in rural area (Wong and Brown, 2009). The rapid growth of urbanization, increasing population associated with the growing demand of water has led to striking challenge in the management practice of water resource developed and developing world. Thus, growing urban stress is one of the important features of water crisis in many developing countries. Further climate change also leads to overall negative impact on water resource such as change in hydrological cycle, degradation of water bodies etc. (GWP, 2012), alongside human activities are also presumed to be the other factor that puts pressure on fresh water resource. Reducing per capita supply, huge water wastage, growing inequality in access to water and its inefficient pricing across the different classes are some of the problems faced by the urban area relating to water (Mukharjee et al., 2007).

Current water stress and scarcity issues illustrate the importance of Sustainable Management of water resource. Water resource management is an important parameter for the development of any nation as it directly relates to the growth and development of economy (Mitchell, 2002). The growing population in the world is consuming more water and on the other side climate change is reducing the water availability in many regions. Therefore sustainable management of freshwater resource is a key development priority to meet the growing demand of water and to achieve secure and sustainable water for the future (GWP, 2012)¹. UNESCO (2003) states that a key component of non structural approaches to water resource management is a focus on using water more efficiently and recollecting more effectively among existing users. Water is wasted nearly everywhere and until real scarcity impacts, most people continue to take access of

¹ GWP: Global Water Partnership. It is an international network created to foster an integrated approach to water resources management. GWP was founded in 1996 by the World Bank, the United Nations Development Program (UNDP), and the Swedish International Development Cooperation Agency (SIDA). Its mission is to support the sustainable development and management of water resources at all levels.

freshwater for granted. Low water price have hampered the introduction of water saving technologies and contributed to its overuse. Loucks (2008) mentioned everyone involved in water management and development has to assure that these systems should provide sufficient quantities and qualities of water at acceptable prices and reliabilities, while protecting the environment and preserving the biodiversity. Therefore implementation of successful integrated water management action will lead to economic efficiency, social equity without compromising ecological sustainability (GWP, 2012).

1.2. Literature Review

1.2.1. The Concept of Sustainable Development

The concept of sustainable development was first publicise by the International Union for the Conservation of Nature and Natural Resources (IUCN) in “The World Conservation Strategy” (IUCN, 1980). It focused on the idea of sustainable utilization of resources and pleaded for “ the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the need and aspiration of future generation”. The idea of sustainable development was brought into the attention of the world by World Commission on Environment and Development (WCED) in its report “Our Common Future”. According to WCED, Sustainable Development ensures “development that meets the need of present without compromising the ability of future generation to meet their own needs” (WCED, 1987). This report further states that at least the natural system that support the life on the earth (atmosphere, the water, the soils and living beings) must not be threatened.

Although the concept of sustainable development gained its importance after the publication of “World Conservation Strategy” of IUCN (1980) and the report of WCED (1987) “our common future”, the idea about sustainability dates back to Malthusian theory of environmental limit. Later at the wave of Malthusian theory it was club of Rome in its report “ limits to growth “ (1972) which focused on depletion of non renewable and resulting increase in commodity price. It assumed that population and industrial capital would continue to grow exponentially leading to similar growth in population and demand for food and non renewable resources. It was one of the

important documents about ecological limits to economic and demographic growth. These ideas were considered as the precursor of the idea of sustainability.

The concept of sustainable development is important in understanding the relationship of humanity with nature and between the people. It is the result of growing awareness of the global links between environmental problem, socio-economic issues to do with poverty and inequality and concerns about the healthy future for humanity. It strongly links environmental and socioeconomic issues. WCED definition and idea about sustainable development expressed in the report *Our Common Future* recognizes the dependency of human on environment to meet the need and well-being in much wider sense than merely exploiting the resource (WCED, 1987). Sustainable development is fundamentally about reconciling development and environmental resource on which the society depends. Sustainable development mainly comprises of three equivalent components-economic, environmental and social development and three dimensions of wellbeing economic, ecological and social and they are interrelated and complimentary. Social progress implies an equitable share of the benefits and burdens of resource use; economic development call for growth, employment and better living standards for all and environmental sustainability is based upon recognition that Sustainable Development cannot be achieved if natural resource and energy are utilized faster than the earth can replenish them, or waste and pollution are produced faster than the earth can accommodate them (UNITAR, 2005).

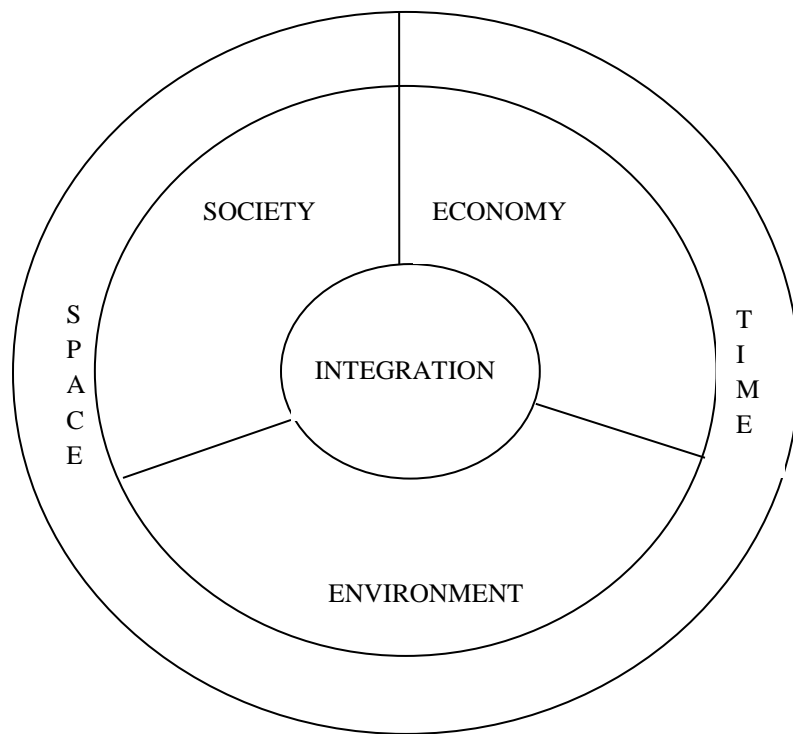
Highlighting the importance of three sectors (environment, economy and society) Giddings et al. (2002) mentioned the concept of sustainable development indicates the intersection between environment, society and economy. The economy is dependent on society and environment, while human existence and society are dependent on and within the environment. The division of these sectors will not produce the integrated or principal based output for sustainable development. It is further argued that sustainable development in order to have long term meaning it is important to have integrated and principal based outlook on human life and on the world we live in.

Mebratu (1998) explains the base for the development of the concept of sustainable development. He states the development of industrial society that has led to

incredible growth of global economy during the last five centuries exceeded most of the ecological limit. The continuous development of technological power showed the degradation of global environment and the natural environment showed the sign of degradation, it is in this notion the concept of sustainable development began to fertilize.

Saxena and Rao (1990) further states sustainable development is an expanded view of conventional development evolved in the recent past. It earned recognition only after it was realized that the present direction of development are not likely to last long and are likely to threaten the precious natural process on which every survival of mankind depend. The conceptual framework of sustainable development though still passing through the phase of refinement has succeeded to find common solution through collective effort for secured and better future.

Figure 1: Conceptual Framework for Sustainable Development



1.2.2. Sustainable Water Resource Management

Human demand on world available water continues to grow as the global population increases and is depleting the available water supplies. With growing scarcity of water and its deteriorating quality water resource management is becoming more challenging with the passage of time. Gleick (1998) focused on water crisis and path to sustainable water use. He states wide range of ecological and human crisis results due to inadequate access and inappropriate management of clean and freshwater resources. Regional conflict on water, ecological degradation and human illness and human death has become more frequent and serious due to increase in human population. Various sustainability criteria have been discussed in order to reshape the long term water management. He further mentioned principles of sustainability and equity will help to bridge the gap between the need and want of water.

Badhur (1998) introduces the importance of fresh and clean water for human survival and maintenance of ecosystem. His study outlines the importance of integrated water resource management for sustainable development and mentions long term planning with local participation as an essential strategy for water resource management in the Himalayas. Richter et al (2003) states in order to manage water to meet the human needs, the need of freshwater species and ecosystem have been largely neglected and there has been tragic ecological consequence. Healthy freshwater ecosystem provides a wealth of goods and services for the society, so it must be better managed. Discussing about ecological sustainability in water resource management they mentioned that this will help to design and implement a water management program that stores and diverts water for human purpose in a manner that it does not affect ecosystem and it will help both man water demand and ecosystem requirement to define, refine and modify to meet the human need and ecosystem sustainability in future.

Groot and Kallis (2002) while examining about sustainable urban water resource management stated increasing demand of water service, decreasing quantity and quality of freshwater decreasing infrastructure pose serious threat in the field of water management in urban area. Various key actions that can contribute to sustainable management of water like efficient public participation in making various decision

about water in terms of proper pricing, integrating policies, management, conservation has been discussed. They argued that envisaging new way for water management and commitment on policy for conservation of water will only help to ensure water for the future.

1.2.3. Urban Water Resource Management

Today the proportion of world's population living in urban area suppress those living in the rural area (Wong and Brown, 2009) and this has presented a great challenge to urban water management. Urban water management is highly complex and fundamentally important issue; it possesses a range of management aspects including water resource allocation planning, urban development planning and environmental protection each of which has different goals and priorities. Thus a comprehensive urban water management system that can address all the management aspects is initial to ensure that urban communities have access to safe and reliable supplies of water.

Vo (2008) discussing about the challenges faced by Ho Chi Min city in terms of water resource management states apart from lack of water resource, improper management and absence of integrated approach has led to water stress in the city. He argued that inadequate institutional arrangement and fragmentation of management practices are the critical causes of water problem in Ho Chi Min city.

Collins (1985) in his work highlights various challenges faced by United States in urban water resource management. It has been mentioned that growing intensity in the use of water in urban area of United States led to significant change in the water supply, utilization and protection. Water suppliers were adopting conservation, reuse of water and better water use management to deal with limited capacity of water during the period of high demand. He further mentions public involvement and integrated management of water is required to address the water problem in urban environment.

The importance of Integrated Urban Water Resource Management in order to mitigate various challenges regarding water scarcity faced by many urban cities has been discussed in the work of Bahri (2012). It has been analyzed that adopting Integrated Urban Water Management and its adaptive process will help cities significantly reduce

the number of people without access to water and sanitation by providing water service of appropriate quality and quantity and thereby improving the health and productivity of urban residents. Discussing about urban water resource management Daigger, G. (2009) highlighted the importance of shifting from traditional approach of water management to other alternative approach as traditional approach are proving to be unsustainable leading to water stress and unsustainable consumption of resource. He mentioned the importance of alternative approach in order to achieve economic, environmental and social sustainability. Storm water management and rainwater harvesting, water conservation, reclamation and reuse, energy management and source spreading are considered as an important approach to develop urban water resource management system. Unsal (?) giving an example of Istanbul city mentioned illegal construction as one of the very important problem of most of the growing urban areas and has seriously affected the catchment area that supplies water to the city.

The study on water resource of Darjeeling has been presented in the work of Das, (2010), where he focused on water crisis in Darjeeling town and the problem faced by the people. Various issues like leakage, massive deforestation, drying up *jhoras*, faulty distribution network, and high population growth has been considered as the main causes for water scarcity in Darjeeling. Roof top rain water harvesting has been suggested as the best method for conservation of water in the town.

Chettri and Tamang (2013) discussed the problem associated with population growth due to rapid urban development in water resource of Darjeeling Town. The study also highlighted the policies adapted by municipality in order to mitigate the problem of water in the town. Khawas (2003) presented a detail study on urban management in Darjeeling Municipality. While discussing about urban management, he highlighted the status of Darjeeling Municipality in terms of management of the most basic urban services like water supply, sewage and sanitation, solid waste drainage etc and argued that Darjeeling municipality still suffers from institutional and planning issues.

The literature presented above attempts to understand various facets of sustainable water resource management and is the basis of the presents study. The idea of sustainable development indicates the balance on economic, environmental and social needs allowing

prosperity for now and future generations. The concept of sustainable development is important in understanding the relationship of humanity with nature and between the people. It is due to growing awareness of the global links between environmental problem, socio-economic and inequality and concerns about the healthy future for humanity the idea of sustainable development came into light.

Water resource is accepted to be the growth limiting factor for the development at local, regional and national level. It has become the topic of high interest featuring everyday in the media, the agenda of politicians and in the mind of public. The literature focused on the significance of management of water in a sustainable manner and various problems and issues relating water resource management especially in the urban areas due to rise in population, development in the standard of living. The existing literature also tries to incorporate the importance of water resource and its sustainable management in order to meet its growing demand and to achieve secure and sustainable future. Such studies were found to have undertaken at global scenario but were missing in towns and cities of hill areas. Although the Himalaya is considered to be the water towers, many hill regions face acute problems relating to the availability and supply of water. Thus, this study attempts to study various facets of water resource management in hill area with special emphasis on Darjeeling Town.

1.3. Rationale of the Study

The increasing trend of urbanization, industrialization and rapidly growing urban population has severely affected the water resource in the urban area. Urban population has been growing at much faster rate than the total population and this has placed tremendous pressure on water resource due to which water has now become one of the most critical resources for the worlds growing urban area. Rapid increase in urban population pose various effects the water resource like illegal construction hampering the catchment area, leakages due to improper management, depletion of groundwater, increase in demand etc. Thus sustainable management of water is considered as one of the key development priority to meet the growing demand of water and to achieve a secure and sustainable water future.

This study focuses on urban water resource management in Darjeeling Municipal Area in the context of sustainable development. Such studies are found to have been undertaken on a global and national scenario but are rare in case of Darjeeling. Studies that have been undertaken about water resources in Darjeeling focus only on water supply issues and population. They lack in various critical aspects like the challenges and the problems encountered by the society due to poor functioning of water supply system, factors affecting the improper management of water resource, study on catchment area that facilitates water to the town etc. This study, therefore, is an attempt to bridge some of the critical gaps highlighted above.

1.4. Objectives

The aim of this study is to examine various facets of water resource management in Darjeeling Municipal Area with the following specific objectives:

- i.* To analyze the growth and development of Darjeeling town;
- ii.* To examine the catchment area that facilitates supply of water to Darjeeling town;
- iii.* To assess the nature and pattern of water demand and supply in Darjeeling town;
- iv.* To understand the role of Darjeeling municipality and involvement of private players in the management and supply of water resource in Darjeeling Town.

1.5. Methodology

The study has been conducted with the aim of understanding urban water management system in Darjeeling Municipal Area in the context of sustainable development. The concept of sustainable development aims to balance our economic, environmental and social needs allowing prosperity for now and future generations. It mainly encourages us to conserve and enhance our resource base by gradually changing the way in which we develop and use our technologies. Thus, the concept of sustainable development has been used to examine and understand the urban water resource management in Darjeeling Municipal Area.

In order to meet the above mentioned objectives mainly mixed method has been used for the study. This method is a procedure of collecting, analyzing both quantitative and qualitative data within a single study to understand the research problem more completely (Creswell, 2002). The rationale for using mixed method is that neither the quantitative nor qualitative methods are sufficient by themselves to capture the details of the situation, thus when quantitative and qualitative methods are used in combination they complement each other and allow for more complete analysis (Green et al., 1989).

Both primary and secondary sources of data have been used for the study. Primary data were collected through survey, interview and field observation. Survey was conducted in order to obtain individuals' views, perceptions of people about the existing water use and management of water resource in the study area. The survey was conducted in respect of three different consumer types namely domestic consumers², commercial consumers³ and institutional consumers⁴ in order to have an idea of water supply and management system from different perspectives. The survey was conducted with the help of a structured schedule that included both open ended and close ended questions. This has been done with the aim that, close ended questions will help to capture direct answers from the respondents and open ended questionnaire will allow the respondents to express their views as they wish.

Structured and semi structured Interviews were conducted, with the officials of Darjeeling Municipality, staffs of water work department and with private stakeholders to have an idea about water availability from the supplier's point of view. Interview schedule contained both open ended and close ended questions. Interview was conducted as this is one of the most important and valuable source for gathering information. Further this will help to understand the significant and important aspects of the problem. Field observation was conducted in order to examine the catchment area that supplies water to the study area.

Darjeeling Municipality consists of thirty two wards; these wards were divided into two zones in terms of high water scarcity and low water scarcity. Each group was

² Domestic consumers include household consumers.

³ Commercial consumers include high and low income hotels, restaurants.

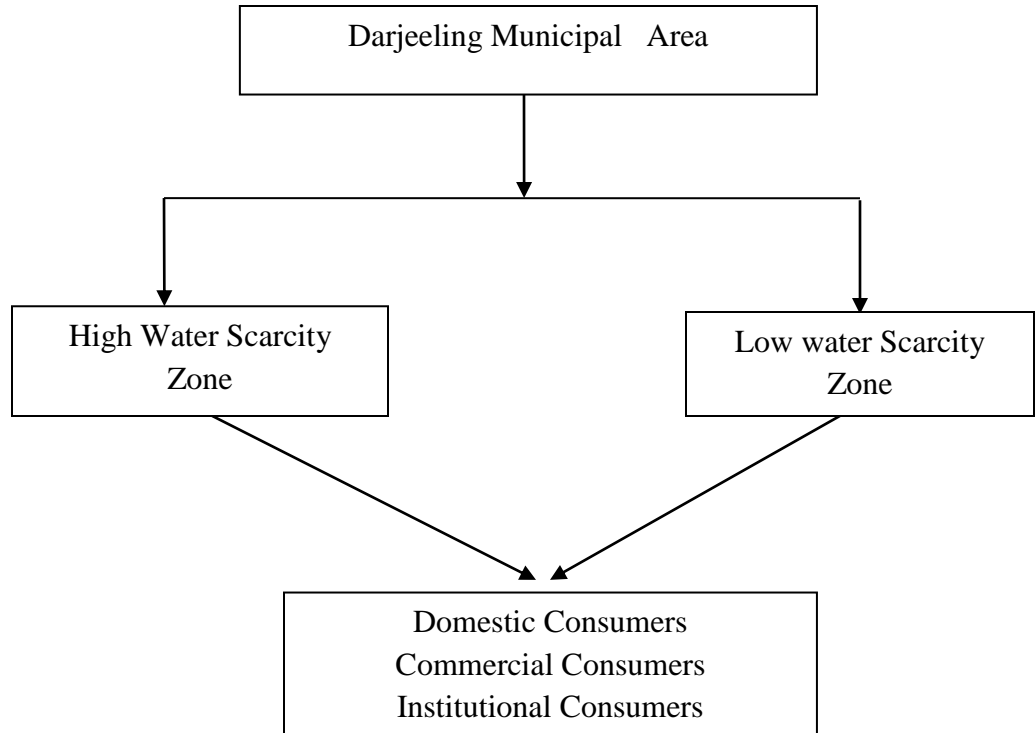
⁴ Institutional consumers include government and non government offices, schools, colleges etc.

further sub divided on the basis of consumers' namely domestic consumers, commercial consumers and institutional consumers for sample size. Simple random sampling method was used for the selection of consumers from each zone. Overall 110 samples were taken for the study, in which 75 of them were domestic consumers, 15 were commercial consumers and 5 of them were institutional consumers. Further 8 were private vendors, 2 were municipal officials and 5 were ward councilors that were surveyed and interviewed respectively. Purposive sampling method were used for the selection of key informant like officials of Darjeeling municipality, members of water work departments, ward councilors from whom the information about the general aspect of water availability can be acquired. This technique was used because of the fact that it yields satisfactory results for the purpose desired (Goode and Hatt, 1987).

Relevant journals, articles, books, municipality databases like annual report, statistical handbook, and internet websites were referred for the collection of secondary data required for the study in order to understand the phenomena in the wider perspective.

Finally, the data collected from the field study were coded, summarized and analyzed using relevant statistical techniques to come up with the appropriate results. The results of the study have been presented using both qualitative and quantitative techniques. Simple statistical tools such as frequency, average, percentage are used for the analysis of data and the outcomes of the analysis are presented through bar diagrams, pie charts, graphs etc. Further mapping of study area and catchment area has been done with the help of Geographical Information System.

Figure 2: Framework of Primary Survey



1.6. Organization of Chapters

The study has been divided into five chapters and the organization of chapters is done on the following sequence:

Chapter one covers the introductory part of the study. It includes background of the study followed by reviews of literature based on various aspects like the concept of sustainable development, sustainable water resource management and urban water resource management. The chapter also contains objectives of the study and methodology used to attain the objectives.

Chapter two presents the study on the growth and development of Darjeeling Town. It includes historical overview of Darjeeling, factors relating to its development and also the development of infrastructures in Darjeeling.

Chapter three presents the study on various sources of water resource available in Darjeeling.

Chapter four presents a study on the governance and management system of water resource in Darjeeling and the role of Darjeeling Municipality in the management and supply of water resource in the town. The chapter also tries to incorporate the role of private players in water supply service and the role of communities in the management of available water resources. The chapter further presents various factors responsible for scarcity of water and improper management of water resources in the town.

Chapter five concludes the study with summery of findings and also provides possible recommendations for sustainable management of water in Darjeeling.

CHAPTER 2

GROWTH AND DEVELOPMENT OF DARJEELING

2.1. Introduction

The district of Darjeeling is the northernmost District of West Bengal located in the lap of the Himalaya. It is located between 26° 31' and 27° 13' North Latitude and between 87° 59' and 88° 53' East Longitude (Dash, 1947). Darjeeling Himalaya covers an area of about 1,721 sq. kms while the total area of the district is 3202 sq. kms (Khawas, 2002). Darjeeling Himalaya forms a part of Eastern Himalaya and, it is bounded by Sikkim on the north, on the west by Nepal and on the east by Bhutan. It comprises of four sub divisions namely Darjeeling Sadar, Kalimpong, Kurseong and Siliguri. Darjeeling Himalaya consists of first three sub divisions of the districts (Darjeeling Sadar, Kalimpong and Kurseong) while Siliguri is mainly characterized by the Terai and foothills of the districts. Darjeeling town is the principal town and the administrative headquarter of the district.

Darjeeling Himalaya consists of the portion of outlying hills of lower Himalaya and the stretch of territory lying along the base of the hills which is known as Terai. The entire hilly region of the district comes under "Gorkhaland Territorial Administration", an autonomous administrative body under the state of West Bengal. Darjeeling has always been a famous tourist destination and is popularly known as "Queen of Hills" due to its majestic natural beauty. The hill is mainly surrounded by the tall Himalayan Mountains and beautiful valleys. This splendid hill station is also well-known for tea plantation. The largely spreaded tea garden also adds a lush beauty to the town. The exquisite scenic grandeur and invigorating climate of the area have earned the title "Queen of hill station" (Chakraborti, 1989).

Darjeeling is mostly famous for three T's Tea, Tourism and Timber and these are also the most significant contributors of Darjeeling economy. Tourism is the climate based industry and is reported to be the only location in eastern India where large number

of foreign tourists visits. On the other hand tea plantations that have earned fame for Darjeeling Himalaya is a major contributor of the climate.

River Teesta is the master stream while Raman and Rangit are the two important tributaries of Teesta. Teesta is a broad mountain torrent with numerous shallows and rapids; it rises in the glacier in north Sikkim 21,000 feet above sea level and drains the whole of Sikkim (O'Malley, 1907). Rangit enters the district from Sikkim on the northern boundary and it receives the Ramman on its right bank. The meeting of Rangit with Teesta provides one of the picturesque scenes along its course (Dash, 1947).

Darjeeling hill experiences cool and pleasant climatic condition. According to Bomjan (2008) the climate of Darjeeling falls under Cwb⁵ climatic classification. The summers are mild with the maximum temperature barely exceeding 25° C and the monsoon season is characterized by torrential monsoon rains. During winter the average temperature ranges between 5°-7° C, temperature seldom drops below the freezing point leading to occasional snowfall. The region receives an annual mean maximum temperature of 15.98° C and the mean minimum temperature of 8.9° C with the mean monthly temperature ranging from 5°- 17° C. The region receives an average annual precipitation of 309.2 cm (121.7 inch) with the maximum precipitation occurring in July. The region receives an average of 126 days of rain in a year⁶.

2.2. Historical Overview of Darjeeling District

The name “Darjeeling” is said to be derived from “Dorjeling” which means a place of “Dorje” a mystic thunderbolt of the Lamaist (Buddhist) religion. Darjeeling is mainly a creation of 19th century. The territory of Darjeeling located in the Singalila range of Eastern Himalaya historically belonged to Raja of Sikkim until early 19th century. It was during the middle of the 18th century the Gorkhas won Sikkim along with Terai (O'Malley, 1907). While East India Company was busy expanding their territories in the

⁵ These climates are dominated all year round by the polar front, leading to changeable, often overcast weather. Summers are cool due to cool ocean currents, but winters are milder than other climates in similar latitudes but usually very cloudy.

⁶ India Meteorological Department, (IMD) Ministry of Earth Sciences, Government of India. <http://www.imd.gov.in/doc/climateimp.pdf>. (Accessed on 19th March 2014).

south, Nepal had already become the strong nation by expanding its areas from Teesta to Kangra along with several plains in 1800 (Khawas, 2002). East India Company waged war against the Gorkhas of Nepal during 1814 to 16 and defeated them; this subsequently led to signing of treaty of Sauguli in 1815. According to the treaty, Nepal had to surrender all those territories which the Gorkhas had annexed from the king of Sikkim (i.e. the area between Mechi River and Teesta River) to British East India Company. It was followed by treaty of Titalya, on 10th February 1817, with this treaty East India Company reinstated all the tract of land between river Mechi and river Teesta to Raja of Sikkim and guaranteed him sovereignty (O'Malley, 1907). Sikkim was then maintained as a buffer state between Nepal and Bhutan.

Ten years later i.e. during 1827-28 dispute aroused on Sikkim and Nepal frontiers. In 1828 the two British officers Captain Lloyd and Mr. Grant were deputed to deal the disputes. On the way to settling dispute they spent few days in Darjeeling and were very much attracted by the site and found the place advantageous and suitable for sanitarium (Chatterji, 2007). They found the healthy environment and the pleasant climatic condition of the place very much suitable for establishment of winter capital and military base for British troops. Darjeeling during those times was a large village under the Kazis (ministers) of the King of Sikkim. However, on the effort of Captain Lloyd who was directed to open negotiation with the king of Sikkim for the cession of Darjeeling succeeded in obtaining a deed of grant from him. The deed of Grant read as follows:

“The Governor- General having expressed his desire for the possession of the hill of Darjeeling on account of its cool climate for the purpose of enabling the Servants of his Government, suffering from the sickness, to avail themselves of its advantages, I, Sikkim puttee Rajah, out of friendship for the said Governor – General, hereby presents Darjeeling to the East India Company, that is, all the land south of the Great Rungeet river, east of Balasan , Kahail and Little Rungeet rivers, and west of the Rungno and Mhanauddi rivers”. (O'Malley, 1907)

It was thus on 1st February 1835 the King of Sikkim handed a strip of hill territory that included all the south of Great Rangit river, east of Balasan, Kahali and Little Rangit rivers and West of Rungno and Mahanadi rivers as a mark of friendship to Governor General Lord William Bentinck for the establishment of sanitarium, with the view to enabling the British servants avail the healthy weather of the place. In return the King received the allowance of Rs 3000 as compensation and this was raised to Rs 6000 per annum in 1946 (O'Malley, 1907).

After the cession, the region started developing in its various forms. In 1839, Dr. Arthur P. Campbell, a member of the Indian Medical Service and the British resident of the court of Nepal was appointed as the first Superintendent of Darjeeling. He turned the area into an excellent sanatorium with his effort and also improved the communication system. By 1940 road was constructed from Pankhabari, hotels for the tourists were started in Kurseong and Darjeeling, European houses, bazaar, jail and accommodation for sick were built by 1850. Darjeeling Municipality was established on 1850. Further road connecting Siliguri with the Grant Trunk Road measuring 126 miles starting from Karagola Ghat opposite Sahibgunge on the East Indian Railway were completed in 1866 (Dash, 1947). At the same time the opening of railway in 1881 brought an important addition to the road communication system in Darjeeling. In 1841 Dr. Campbell started the experimental growth of tea plant which was also followed by the establishment of tea plantation industry on a commercial basis within the due course of time.

Kalimpong which was part of Bhutan was annexed by British and included in Darjeeling in 1866. Until mid 19th century the area of Kalimpong was ruled by Sikkim and Bhutanese kingdom. It was in 1706 the king of Bhutan won the territory from Sikkim monarch and renamed it as Kalimpong (under Sikkim's rule the area was known as Dalingkot). After Anglo- Bhutan War (1864), the treaty of Sinchula was signed in 1865 in which Bhutanese held the territory east of Teesta River was ceded to the British East India Company (Dash, 1947). The Kalimpong area was first notified as a Subdivision under the Deputy Commissioner of the Western Duars District and in 1866 it was transferred to the District of Darjeeling (Dash, 1947).

After Kalimpong was brought under the British Administration the District was divided into two Subdivisions. The headquarter subdivision with an area of 960 square miles which included all the hills of both sides of Teesta, and the Terai subdivision with an area of 274 square miles which included the whole area at the foot of the hills (Dash, 1947). In 1880 Siliguri area was taken out from Jalpaiguri district and was included in Darjeeling District. Though the shape of Darjeeling remained unchanged but the political placement kept on changing from time to time. The district of Darjeeling was annexed to Rajshahi after 1850. In 1905 the region in the present shape was included in the Bhagalpur of Bihar but had to be taken away to Rajshahi again in 1912 with the re arrangement of the province (Khawas, 2002).

After independence of India in 1947, Darjeeling was merged with the state of West Bengal and the separate district of Darjeeling was established consisting of Darjeeling, Kalimpong, Kurseong and Siliguri Subdivisions. The demography of the region changed substantially when the people's republic of China annexed Tibet in 1950 and thousands of Tibetan refugees settled across the district of Darjeeling (Dasgupta, 1999).

Darjeeling District at present is a multi-ethnic, multi-cultural and multi-lingual area with diverse ethnic population. The social groups blended with diverse ethnic and linguistic origin, representing various racial status have found a place for themselves. The waves of migration during the colonial period have drawn large sum of the people from surrounding territories of the Himalaya to Darjeeling. Today, Nepalis are found to be the dominating rank in Darjeeling and the others are mainly Bhutias, Lepchas, Tibetans, Bengalis and Rajbansis etc. Thus, it is due to the blend of diverse ethnic and cultural elements, the region is abode of large variety of inhabitants.

2.3. Factors for the development of Darjeeling

The historical analysis on historical development of Darjeeling reveals various factors that have led to evolution and growth of Darjeeling. One of the major factors that motivated and encouraged English East India Company to move towards Darjeeling was its cool and pleasant climatic condition. The British rulers were highly influenced by the

pleasant climate of Darjeeling. They found this place suitable and advantageous for setting up sanitarium and health resort for British officials and businessmen. Various forms of development started taking place in Darjeeling with the preparation of developing it as a sanatorium. Various roads were constructed, buildings schools, hotels, schools, bungalows, hospitals, theater hall were built up for the British and Europeans. All these forms of development further encouraged the growth of Tourism in Darjeeling.

Other factor that encouraged the British rulers to move towards Darjeeling was the growth of tea industry in the district. It was in 1841 Dr. Campbell started the experiment of growing tea plant in Darjeeling. The tea cultivation flourished rapidly on a commercial scale in the district from 1856 onwards and attracted significant number of British in Darjeeling (O'Malley, 1907). The average yield and income from the tea industry had predominating influence on growth and development of Darjeeling. One such influence was improvements in the transport and communication system, various roads network were constructed to connect Darjeeling Hill area with the plains. Darjeeling Himalayan Railway was also opened up in 1881 with the practical aim to carry tea to the plains. Along with the tea plantation, the prospect of forest products and cinchona plantation also attracted British rulers towards Darjeeling. More than 90 percent of the hill area of the district was covered by the forest area which contained variety of species laden with immense possibilities for commercial utilization (O'Malley, 1907).

Other important factor that attracted British towards Darjeeling was its geo-political importance being a part of Sikkim. The two main ranges of Himalaya the Singalia range and Chola range enclosed Sikkim on the North of Darjeeling District and were bounded on either side by Nepal and Bhutan. The boarder Kingdom of Sikkim touched Nepal, China, Bhutan and India (Dasgupta, 1999). Trade became an important form of economic activity in Darjeeling, the trade route from Kalimpong –Lasha was the shortest one from India to Tibet. After the annexation of Darjeeling from Sikkim, Bhutan and control of Nepal the British started to increase trade with Sikkim, Nepal and Tibet through Darjeeling (Chatterji, 2007). Throughout the 19th century the volume of trade through Darjeeling increased to high extent and the central Asia trade through Himalayas on the other hand appeared to be more interesting and fascinating.

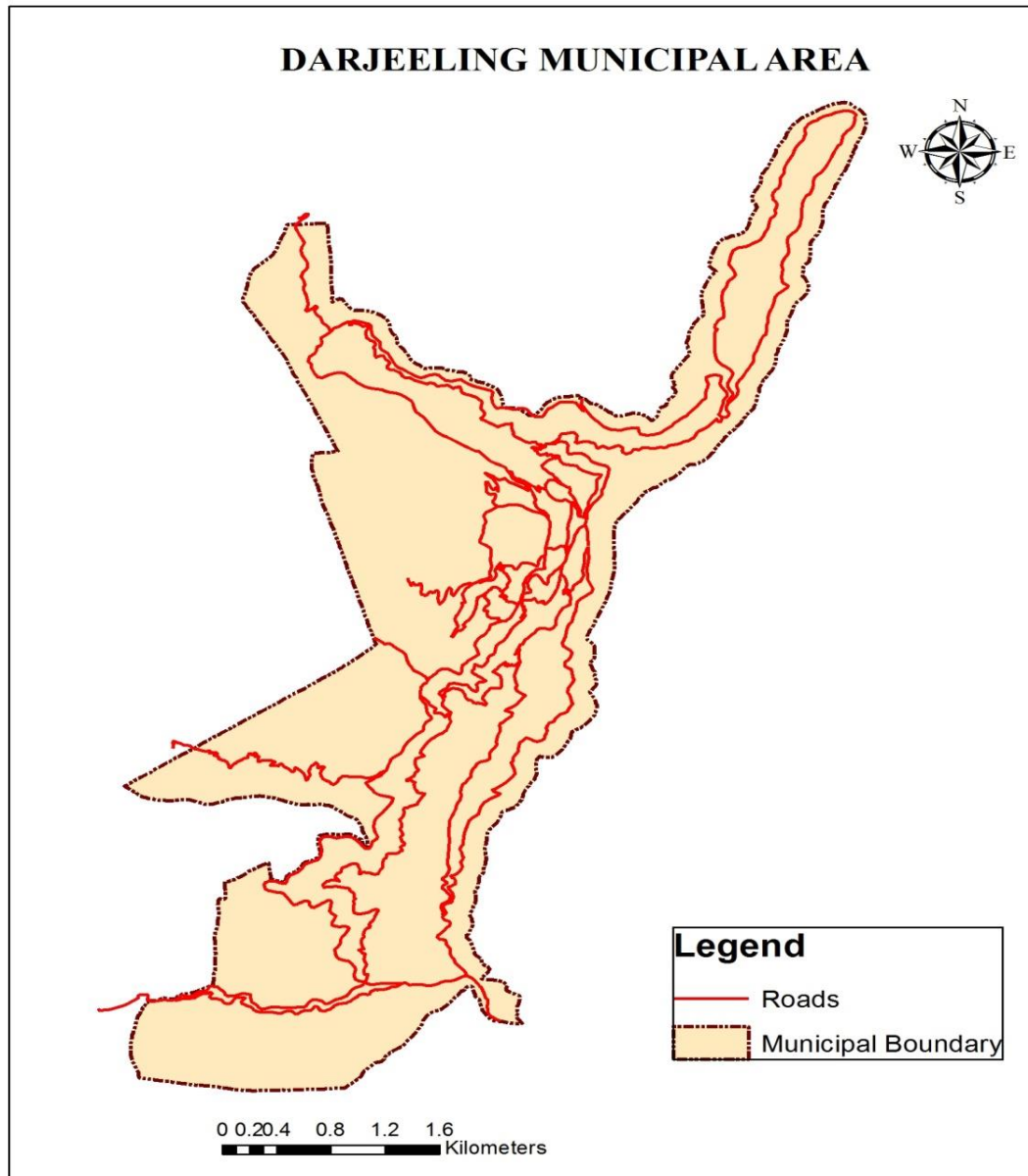
2.4. Growth and Development of Darjeeling Municipal Town

2.4.1. General Profile

The town of Darjeeling is situated on the lower part of Darjeeling- Jalapahar ridge in the Siwalik Himalaya. The town is the headquarter of the district and is largest among the hill towns situated on the district. Darjeeling town is located between 26° 31' to 27° 31' North Latitude and 87° 59' to 88° 53' East Longitude at an average elevation of 6982 ft (2128m) (Dozey, 2011). It is a ridge shaped like English letter 'Y', the base resting at Katapahar and Jalapahar while two arms diverge from the Mall, one dipping suddenly to the North East and ending in the Lebong spur, the other arm running North West passes through the St. Joseph's College and finally ends in the valley near Tukver Tea Estate. The region covers an area of 10.75 km² and consists of 32 wards. It was established by the British in the year 1850 and is one of the oldest municipal towns in the country (Dash, 1947).

The growth and development of the hill towns of Darjeeling and the other hill towns are somewhat different from that of plains. These hill towns were predominantly a seasonal trip of Britishers, which were selected by them for their own comfort and need whereas the cities of plains had multifunctional values (Das and Bhumali, 2011). Besides the natural increase of the population migration is the moving force behind the urban growth in Darjeeling.

Figure 3: Darjeeling Municipal Area



Source: Darjeeling Municipality Office, July 2014

2.4.2. Darjeeling Municipality: A Brief Background

Darjeeling Municipality is mainly responsible for the civic administration of the town of Darjeeling and it is one of the oldest cities administrative bodies in India. Darjeeling Municipality was established on 1st July 1850 (O'Malley, 1907). Darjeeling Municipality originally constituted an area of 138 square km; it included the whole tract that was ceded by the Raja of Sikkim to East India Company in 1835. It extended from the hill below Pankhabari to the borders of Sikkim in the North. Darjeeling Municipality at present covers an area of 12.5 square. Km (4.85 square miles). The area extends from Jorebonglow in the south, extended to the point to Takvar below St. Joseph College on the north and it is bounded by Calcutta road in the east. The municipality boundary covers Chowrasta road and Bhutia Basti and joins below St. Joseph College. The boundary line continued past and below the bazaar through Happy Valley tea estate until it reaches the boundary below St. Joseph College.

Until 1916 the administration of Municipality was governed by the Bengal Municipal Act (III of 1884) and by a Special Act (Act I of 1900). For the purpose of administration the town was divided into 9 wards and a committee with a group of commissioners to look into the affairs of each ward (O' Malley, 1907). Dash (1947) mentioned the Bengal Municipal Act (XV of 1932) now regulates the municipal administration. Till 28th August 1988 Darjeeling Municipality was placed in the 'D' category of the state municipality (based on the criteria of population). In view of the various problems faced by the hill municipalities different from their plain counter parts the government of west Bengal vide letter No. 569/MA/O/C- 4/1A-1-18/95 dated, 12th October 1988 upgraded Darjeeling municipality from 'D' to 'A' category based on the criteria of population and number of wards were increased from 26 to 32 wards (Khawas, 2003).

Further bifurcation of wards had taken place during the period of 1991 to 2011. Ward number 5, 6, 13, 21 and 28 were the wards that were bifurcated. According to the Municipal record increase in population within the ward, inter ward migration and decrease in municipal limits due to conversion of some regions into panchayat area were

known to be the major reasons for bifurcation of wards. As per UDPFI⁷ Standard for Hill Areas, Darjeeling Municipality is classified under large city, so for the convenience and economic consideration of planning the whole Municipal Area is divided into seven zones. These zones are made according to the continuity of the wards and the wards which are close together are clubbed in a single zone.

Table1: Zone Wise Distribution of Wards

Zones	Ward Numbers
Zone A	1 (part), 2, 3, 4, 5
Zone B	31, 32
Zone C	14, 13, 1 (part), 11 (part)
Zone D	23, 28, 29
Zone F	11(part), 6, 7, 8
Zone F1	10, 15, 19, 20, 21, 24, 25, 26
Zone F2	9, 12, 16, 17, 18, 22, 27, 30

Source: Darjeeling Municipality Office, July 2014

2.4.3. Growth of Population

Darjeeling presents a remarkable example for the growth of population. During 1835 when Darjeeling was gifted to British by the king of Sikkim as a token of friendship, the region had a collection of about 20 huts with a population of about 100 souls (Dozey, 2011). Later with the development of region as a sanatorium and health resort population of Darjeeling increased to 10,000 by 1850. One of the most important factors contributing to the growth of population in Darjeeling has been the growth of Tea industry. Growth of tea industry resulted in the huge demand of labor force. The populations of local inhabitant were found insufficient to solve the problem of rising labor force, thus Britishers were compelled to invite the outsiders to Darjeeling, and this led to massive increase in population in Darjeeling. Introduction of tourism and massive construction works (like expansion of roads, construction of urban centers etc.) are the

⁷ UDPFI –Urban Development Plans Formulation and Implementation guided by Ministry of Urban Affairs and Employment.

other important factors that encouraged more and more immigrants from the neighboring countries to Darjeeling. Thus immigration played a vital role in the increase of population in Darjeeling.

The colonial town of Darjeeling were designed by the Britishers during the early 19th century for the population of 10,000 people of that period, but according to Census of India (2011) the population of Darjeeling town has now increased to 1,20, 414 people and 1,32,016⁸ when the population of Darjeeling urban agglomeration is included. The town further supports the floating population of over 20,500 in the form of tourists, students, visitor's wage earners etc. Such a spurt of population has led to immense pressure on the environment of Darjeeling and made the town more prone to environmental problems in the recent decades.

Table 2: Decadal Population Growth in Darjeeling Municipal Town

YEAR	POPULATION	GROWTH RATE (%)
1901	16,924	-
1911	19,005	12.30
1921	22,258	17.12
1931	21,185	- 4.82
1941	27,224	28.51
1951	33,605	23.44
1961	40,651	20.97
1971	42,873	5.47
1981	57,603	34.36
1991	71,470	24.07
2001	1,07,197	49.98
2011	1,20,414	12.33

Source: Darjeeling Municipality office, July 2014

⁸ 2011 Census data. <http://www.census2011.co.in/census/district/1-darjiling.html>. (Assessed on 5th May 2014)

Figure 4: Decadal Population Growth in Darjeeling Municipal Town (1901-2011)

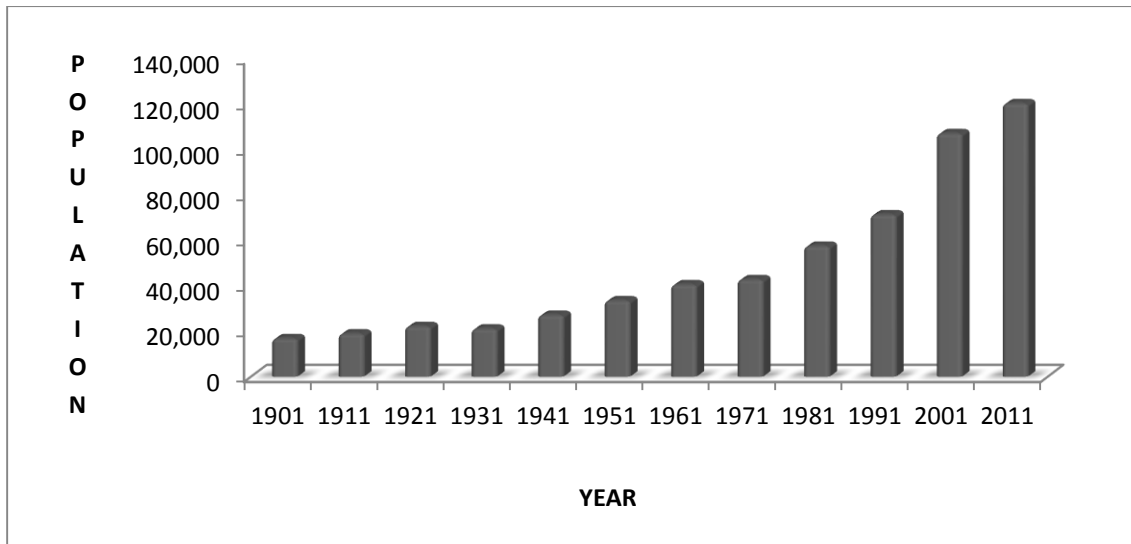


Table 2 represents the trend of decadal population growth of Darjeeling Municipal Town and its growth rate since 1901 to 2011. The town observed fluctuation in the growth of its population. The population of Darjeeling has been increasing ever since it was taken by Britishers from King of Sikkim. All the decades except 1921 to 31 showed positive population growth in the town. This decade can be understood as a great distinctive decade of the town, because only this decade demarcated the population growth in the negative manner. The growth rate of population during this decade dropped down to - 4.82 percent, with reference to some literature it was known that this was mainly due to abnormal mortality due to plague, cholera, malaria, fever along with famines and other natural calamities leading to negative growth rate of population during this decade. Again from 1941 to 2011 the population growth of Darjeeling town showed positive trend. The town has experienced a significant growth of population since 1970's onwards. The highest growth rate of the town was seen during 1990's with 49.98 percent and it was far above the national, state and district level.

Further, during the decade 2001 to 2011 the growth rate of the town went down as compared to previous decade. During this decade mainly flourished the era of globalization and the socio-cultural status of the people were much developed due to increasing literacy level. Specifically growth in level of female literacy rates was

increased, therefore, birth rate declined with declining death rates. This affected the population growth rate and that decreased to the standard level.

The town being the district headquarters acts as a centre for all type of economic activity and thus attracts large number of ruler folks to migrate into the town for the better opportunity. Beside it the pleasant climatic condition of the town, compels the people from the surrounding states to migrate and settle in the town permanently. It is to be mentioned that the Britishers designed the town only for the population of 10,000 people mainly for the European bureaucrats. The rapid increase in the population in the recent decades has exerted severe pressure to the geological and geomorphologic aspects of the queen of the hills.

Table 3: Wards Wise Population Distribution in Darjeeling Municipal Town

Ward no.	Area (sq.km)	Ward wise population			Area (sq. km)	Ward wise population	
		(1971-91)	1971	1981		1991	(2001-11)
1	0.3671	1513	1761	2032	0.3229	4153	3256
2	0.6585	1065	1404	2596	0.4268	2604	4033
3	1.5151	2083	2373	3301	0.0837	3119	2219
4	0.4021	1331	1668	2182	0.6582	3515	3937
5	1.113	2673	3536	5286	0.2847	2389	2679
6	0.4108	2825	4339	5193	0.345	4359	4568
7	0.6002	1175	2164	3490	0.1667	3457	4865
8	0.2943	1893	2705	3694	0.1194	3858	4089
9	0.37587	2892	4203	5015	0.3822	2804	2443
10	0.0542	1139	1322	1172	0.1051	2314	2777
11	0.1107	651	1187	2294	0.1621	2810	3980
12	0.3729	748	1813	3671	0.0843	3278	3632
13	0.2273	1625	2353	2552	0.2476	1545	2263
14	0.0233	1462	1908	2476	0.0931	5499	6442
15	0.0175	1460	1044	1003	0.0413	1281	1750
16	0.0536	1129	1312	1344	0.0991	4526	4647
17	0.5536	1643	1855	1801	0.2751	4882	5172
18	0.227	1561	1837	2446	0.1765	4187	4224
19	0.0175	1109	1409	1175	0.0332	3519	3643
20	0.0425	1355	2022	1798	0.0148	1663	1541
21	0.0892	1901	1955	2223	0.155	1022	1618

22	0.2447	2154	3307	3108	0.302	2358	2191
23	0.9982	1439	2346	2405	0.1743	3249	4965
24	0.4458	2301	2225	3761	0.0188	1288	1354
25	0.7360	2351	2838	3721	0.0186	1766	2164
26	1.1317	1695	2717	3101	0.1059	2279	2950
27					0.1544	3423	3612
28					0.1452	7076	5026
29					0.7836	5604	6209
30					0.4007	3920	4321
31					0.6514	4794	4846
32					0.811	4156	4152
TOTAL	10.6	42,873	57,603	71,470	7.413	1,07,197	1,20,414

Source: Darjeeling Municipality Office, July 2014

2.4.4. Growth and Development of Infrastructure

Health Facility

The town of Darjeeling constitutes some of the most important medical and health institutions in the district. Some of these medical institutions were mainly built during the pre- independence period when Darjeeling was governed by the colonial rulers. Britishers moved towards Darjeeling with the aim of establishing this place as sanitarium and health resort for the British officials. Firstly, the town of Darjeeling had two medical institutions Eden Sanitarium for Europeans and the Lewis Jubilee Sanitarium for natives (Dash, 1947). Eden Sanitarium was opened in 1833; hospital and Operation Theater was added later. It was opened with the effort of Sir Ashley Eden , the Lieutenant Governor of Bengal and it was the only institution in Bengal where the Europeans could get proper care, attention and recovery after sickness in the plain (O'Malley,1907). Similarly, Lewis Jubilee sanitarium was opened in 1887.

Victoria Memorial Dispensary is the Darjeeling Municipal Hospital; it is managed by the committee under Darjeeling Municipality. Since, 1944 it has been taken over temporarily by the Government (Dash, 1947). Victoria Hospital has been recently merged with Eden Hospital and is also known as Sahid Durga Malla Hospital.

Presently there are three other hospitals:

- i) The tuberculosis Hospital was built in 1936

- ii) Sub health post, 16 SHP and one hospital having outdoor – patient department (Eden Hospital)
- iii) Two Maternity and Child Welfare Centre has been established, one in the Darjeeling itself and other at Ghum.

There are three private Nursing homes in Darjeeling namely Planters Nursing Home, Yuma Nursing Home and Mariam Nursing Home with 20 beds each. The Municipal Public Health Laboratory also provides the help in medical and public health work of the town and district.

Table 4: Health Facility in Darjeeling Municipal Town

Name of Hospitals	No. of Beds
Eden Hospital	380 beds
T.B. Clinic	55 beds
Maternity Home	07 beds
Planters Nursing home	20 beds
Yuma Nursing Home	20 beds
Mariam Nursing Home	20 beds

Source: Darjeeling Municipality Office, July 2014

Educational Facility

The Christian missionaries and those of Church of Scotland Mission were the pioneers to spread education in Darjeeling. According to Dash (1947) it was during 1850, Rev. Mr. W. Start, a private missionaries and Mother Teresa M. Mons made their first attempt to reach the hill people by education. Rev. Mr. Start opened schools for Lepchas in Darjeeling and devoted his life in spreading education. Later Rev. Mr. Niebel composed some Lepcha primers and it was in 1869 Rev. Mr. William MacFarlane introduce the broad scheme of vernacular education in Darjeeling. Rev. William MacFarlane fixed Hindi “as the lingua franca” and prepared few text books in Hindi and also induced Government to award scholarships to the students who were attending the schools.

Today the town has 52 primary schools, 12 secondary schools, 21 higher secondary schools and 4 colleges. Municipality is itself managing the two higher secondary schools out its own resources. The town also has one senior and junior B.T. Colleges each. The town also has 6 private pre-primary schools and 88 Anganvari and 5 non formal educational institutes (Municipality Report 2010).

Table 5: Educational Institutions in Darjeeling Municipal Town.

Institutions	Numbers
Primary Schools	52
Secondary Schools	12
Higher Secondary Schools	21
Colleges.	04
Senior B.T. College	01
Junior B.T. College	01
Private pre-primary Schools	06
Anganvari	88
Non Formal Educational Institutes	05

Source: Darjeeling Municipality Office, July 2014

Sewerage and Sanitation

The town of Darjeeling has underground sewerage collection and disposal system and covers 40 percent of the municipal area. The town in the present time generates about 6.6 MCD of Sewerage. The system collects majority of liquid waste of the town and is conveyed to five existing septic tanks which are ultimately disposed in Jhoras (waterways). There are 7 main jhoras and 27 minor jhoras within Municipal area, many other jhoras has been emerged recently with the increase in population and construction of new houses. The town has altogether 109 community latrines, these community latrines are broadly classified into three categories: i) latrines with average facility, ii) latrines with individual tanks and iii) latrines with pits and services. Out of the total number of community latrines 54 of them are connected to five major septic tanks located in four different locations.

The existing sewerage system of Darjeeling Municipal town is age old. It was laid down in 1935 and only covers the area of about 40 percent at present. It was originally intended to serve only the European settlers resided and most of them have almost broken down in the present date. The existing sewerage system has several constraints like most of the sewer network has worn out condition due to age old, the entire sewer mains right from the hill top to septic tank has a uniform diameter pipe as such the load it carries from the hill top with great velocity are often seen overflowing at different inspection pits situated at the lower level due to increase in population and holdings the sewerage mains and tributaries are overloaded maximum time.

The report on the situation of sewerage system of Darjeeling was submitted to the government in 1985. Further estimated project of Rs. 13.65 crores was also submitted to the government to upgrade the entire sewerage system and to bring it to a serviceable standard (Khawas, 2003). However, the project is still gathering dust with the government.

Solid Waste

Darjeeling town adopts primary method of collection of waste by means of bins. Solid waste of the towns are managed and maintained by the Health and Sanitation Department of the municipality. The collection of waste are made with the help of vehicles of the department, they pick up the solid waste from different parts of the towns and disposes off above Hindu Burial Ground. According to Darjeeling Municipality report, 2010 town produces about 63.28 metric tons of solid wastes every day, while the vehicles and personal available are able to collect and dispose only over 60% of the waste, the remaining wastes continues to accumulate in the town on a daily basis. In addition to the waste collection the conservancy labor sweeps the major streets of the town on daily basis.

The road length swept by each conservancy labor comes to around 662 meter per day. It has also been mentioned that the old Darjeeling had a more scientific system of solid waste disposal mainly, by using the ropeways but, due to the population explosion in and around the 1970s the local population forcefully stopped the operation of the ropeway station and was subsequently abandoned and there after it became inoperative.

Today the solid waste is disposed off above the Hindu Burial Ground by four tractors and the disposal sites are in a “pathetic stage”. Repeated requests to the government by the municipality have fallen deaf ear. The municipality feels that the sanctioned staff pattern of the government on the basis of population (e.g. one sweeper for every 1000 population) is detrimental to the hill municipalities. Hence, a separate staff pattern has been requested to the government in view the different geological and geographical characters and hence unique problems (Khawas, 2003).

Table 6: Solid Waste Scenario of Darjeeling Municipal Town

Management Scenario		Important Indicators	
Total Waste Generated/day (metric tons)	63.28	Per Capita Waste Generated (Gms/day)	613
Waste Collected (tones)	31	Collection Performance (%)	62
No. of Vehicles	7	Vehicle Capacity-(% of Waste Generated)	21
No. of Labor engaged in conservancy	150	Road Length/Conservancy Staff (Meter)	662
No. of Disposal sites	1		

Source: Darjeeling Municipality Office, July 2014

Drainage System

The topography of Darjeeling is such that it helps in rapid drainage from the town. There are 7 main Jhoras, 27 minor Jhoras and about 65 km of roadside drain within the municipal area, which starts from Jaldhapara Spur and joins different streams down below. Several other drains have been emerged recently due to increase in the number of households and population. The major portion of the town area is provided with surface drains, the total length of Pucca drains on the edge of the roads is 53.05 Km and the length of Kutcha drain is 12.07 Km (Darjeeling Municipality Report, 2010).

Though Darjeeling does not face major problem of flood as in plains, the topography of Darjeeling faces different types of problem regarding drainage than that of the towns in plains. In the hilly terrain the scouring and erosion of Jhora beds and gullies makes the surrounding area prone to landslides.

Table 7: Drainage System in Darjeeling Municipal Town

STORM WATER			
General Details		Service Levels	
Pucca Covered Drain (KM)	40.98	% of Storm Water Drainage Length to Road Length	60
Pucca Uncovered (KM)	0	% of Pucca Drains to Total Drain Length	85
Kutchra Drain	12.07		
Total Drains (KM)	53.05		

Source: Darjeeling Municipality Office, July 2014

Water Supply

The town of Darjeeling is supplied with water from the Sinchel Catchment Area. Here water is collected from 26 number springs situated in the Sinchel wildlife Sanctuary and is collected in an arrestor tank which brings water on gravity to the ground storage reservoir at Sinchel namely North Sinchel and South Sinchel Lake. Water from the two Sinchel lakes are filtered through the pressure filter situated at Jorbunglow filter house and from there the water is conveyed to the reservoirs situated at St. Paul Tank with the capacity of 2,35,812 galloon and the Rock Valle Tank with the capacity of 56,651 galloon and 58,012 galloon through large water mains (Bomjan, 2008) . From these main reservoirs water is distributed over the town through subsidiary tanks located at various places and are also distributed directly through mains of various diameters. Water from another catchment area known as Rambhi catchment area which has 10 numbers of springs also passes through the Jorbunglow Filter House and is brought to the water tank in Rockville.

This water supply system in Darjeeling Town was designed during the British regime with the target of 10,000 population at that time (Bomjan,2008) but today the population of Darjeeling has increased to 1,20,414 (Census of India 2011)⁹. With the

⁹ 2011 Census data. <http://www.census2011.co.in/census/district/1-darjiling.html>.

(Accessed on 11th May, 2013).

beginning of the tourist season the total population is added by another 25 to 30 thousand of the floating population (Bomjan, 2008) resulting for which water has to be provided and the town still depends on the two reservoirs that were constructed for the population of 10,000 people. So, there is a widening gap between the demand and supply of water in Darjeeling.

Table 8: Overview of Water Supply Indicator in Darjeeling Municipal Town

Component		Service	
Service	Sinchel Lake including 26 natural perennial sources and Rambhi catchment area including 10 natural perennial sources	Supply/Capita-lpcd	70
Total Supply (MLD)	3.35	Network to Road Length	81
Treatment Capacity (ML)	80,000 gallons per hour	% Holding Connected	51
Network Length (km)	95	Storage Capacity (% total)	80
Storage Facilities	Two underground Reservoir of 33.5 MG (Sinchel North and South Lake)	Supply Hours	45 min to 1 hour
No. of Reservoirs	28	Persons/PSPs	163
Capacity MG	33.5	No. of PSPs	500
No. of connection	3300	No. of Booster Pumps	1
No. of Centrifugal Pumps	5	No. of Submersible Pumps	1

Source: Darjeeling Municipality Office, July 2014

Roads and Street lights

All the roads in Darjeeling municipal town except Hill Cart Road and Lebong Cart Road falls under Darjeeling Municipality. Most of these roads were constructed during pre independence period and now due to plying of heavy vehicles and lack of maintenance, most of the roads are in a bad shape. The geology of the area compels all the roads to follow the contour lines therefore; they are mostly serpentine and sloping in nature. The total length of all types of roads including stepped path within municipality is around 90 Km. The road density ranges to about 9 km/sq. km and about 75 percent of the roads are surfaced roads (Khawas, 2003).

Due to rapid urbanization of Darjeeling town in the recent decade, without any land use plan, the main Cart Road now National Highway 55 within the municipal area has become a constant source of trouble that has been caused due to frequent traffic jams. One of the vital bottleneck being the stretch of Jorebunglow where the width of the road is narrow, apart from it railway track and also the Water Mains from Senchal to Darjeeling town runs underneath it. Another important bottleneck to traffic is the rapidly increasing in the number of vehicles repairing shops along Cart Road. All these roadside repair shops lack space making it vulnerable to traffic jam and accidents.

Table 9: Roads Networks in Darjeeling Municipal Town

Sl. no.	Type of Roads	Number	Length (km)
1	Motorable Bituminous Road	40	50
2	Non-Motorable Bituminous Road	61	41.5
3	Water Bound Macadam Road	21	9.50
4	Concrete Stepped Road	25	18.4
5	Kutchra Road	38	13.50

Source: Darjeeling Municipality office, July 2014

According to Municipality report (2010), Darjeeling municipal town has over 6,500 streetlights at present. The town has more than 90 percent of its street made up of low power filament bulbs and has no tube lights. The average spacing of light (no. of street light over road length) is about 64 m while the no of lights per km road comes to

about 16. The major issue here seems to be the spacing of streetlight, which is below the desirable standard of at least 35 meters.

Table 10: Street Light in Darjeeling Municipal town

Street Lights Details			
Sodium Vapour Lamps (Nos)	160	Spacing of Street Lights (M)	64
Tube Lights (Nos)	0	No. of Lights per Km Roads	16
Others (Nos)	1427	% of High Power Lamps	10
Total	1587	Lights per Staff	265

Source: Darjeeling Municipality Office, July 2014

2.5. Conclusion

The growth and development of Darjeeling were different from that of the towns of the plains. The cities of plains had multifunctional values whereas the hill towns were primarily meant for the seasonal trip of the Britishers. Britishers mainly created the hill towns for catering their own needs of comfort and control. For enjoying the both bodily comfort and uninterrupted control over the hill resources, they perused the policy of secluding Darjeeling hills from the plains. Thus the exquisite scenic grandeur and invigorating climate of Darjeeling have earned the title “Queen of hills”.

Darjeeling Municipality is mainly responsible for the civic administration of the town. Since the British first established Darjeeling as a hill station or sanitarium it has been a major focus for tourism and economic development, but today the town of Darjeeling suffers from long year of neglect and is aptly leading to the present situation where there has not been corresponding investment on infrastructure and service provision. The town which witnessed rapid urban development after 1950 has been suffering very much due to unplanned settlement, increase pressure of population over the available resources and increasing natural habitat. On the other hand the available

services such as collection and disposal of solid and liquid waste are inadequate in their coverage and unplanned in their methods.

No introduction of the town planning department in the district of Darjeeling over the period of time is a main constraint that has led to unplanned development and various types of problems in the town. The lack of physical planning such as a detailed land use planning in the area has led to unplanned growth of the Darjeeling town and absolute lack of scope for lateral expansion of the town. Moreover, rapid growth of population, more prominently, in recent decades has contributed in making Darjeeling an unpleasant town to live in. Darjeeling has lost its proud title 'Queen of Hills' over the years. Further, the major physical development programs like, Integrated Development of Small and Medium Towns (ISMT), Integrated Low Cost Sanitation Scheme (ILCS), Environment Improvement Programs have always maintained distance from the hills of Darjeeling including Darjeeling Municipality.

CHAPTER 3

SOURCES OF WATER IN DARJEELING

3.1. Introduction

Water is said to be the hub of the life and an indispensable part of the entire terrestrial ecosystem. Access to sufficient, clean and safe water is fundamental for the proper sustaining of life and development in the urban area. The increasing population, rapidly growing urbanization, growth in the standard of living has posed striking challenge in the availability and management of water resource both in the developed and developing world in the recent time (Biswas, 2006). As the trend of urbanization and population growth continues to proceed water is increasingly becoming a critical component especially for the sustainable development of the urban area. The availability of water for the future generation is not only a regional issue but, is also a subject of concern at a global scale. The first and the most important step in providing safe and reliable supply of water is the selection of the best available source of water. According to Whitlock (1954), the most protected source of water will be the most easiest and cheapest to transform it into the safe drinking water. This is the general principal and one of the important phenomena that has been since the time of Plato.

The water supply system in Darjeeling depends largely on groundwater (springs)¹⁰. Darjeeling Himalaya is mainly characterized by high hills and deep valleys, it is built in a sequence of over thrust pushed southward and dipping in the north. The network of ridges and valleys of the Himalaya follows a dendritic pattern and the slopes of the hills are generally long and steep (Guha et al., 2009). Due to steep slopes of the land, ground water seeps out to the nearby springs and *jhoras* and also gushes out from

¹⁰ Groundwater is the water that lies beneath the surface of the ground and fills the soil pore spaces, fractures of rock formation and other openings. A spring is formed when the side of a hill or valley bottom intersects a flowing body of groundwater at or below the water table, below which the materials are saturated with water. A spring is formed as a result of aquifer being filled to such a point that water overflows onto the land surface.

the joints and fractures in the form of springs but it cannot be developed by dug wells. The terrain condition restricts the construction of bored wells and the development of ground water as well (Guha et al., 2009).

The region of Darjeeling has a good number of perennial and semi perennial water bodies in the form of hilly springs. These available perennial and semi perennial natural springs located in and around the town are the main sources of water in Darjeeling. Due to the higher relief and steeper gradient of the area, ground water comes out as seepages and springs whenever the land surface intersects the local ground water table. Darjeeling is mainly characterized as a high rainfall area with the region receiving an average annual rainfall of approximately 309.2 cm which is one of the highest among the rates of annual rainfall in India. Therefore natural precipitation is the primary source of groundwater in the region. The direct infiltrations from rainfalls through joints, fractures, weathered rock-strewn zones and through soil covers are the principal means through which the springs are recharged. Due to steep hill slopes, maximum precipitation received in the region flows off as surface runoff through streams (*Kholas*) and also through springs. These movements of groundwater are mainly controlled by the structural setup and also by the physiographic setup of the area (Guha et al., 2009).

Some of the major sources of water that facilitate water supply for Darjeeling town are explained below:

3.2. Sinchel Catchment Area

Sinchel wildlife sanctuary is the main water harvesting area for the Municipal Water Supply (MWS) in Darjeeling and the natural springs that originate from Sinchel range provide the major source of water supply in Darjeeling Town.

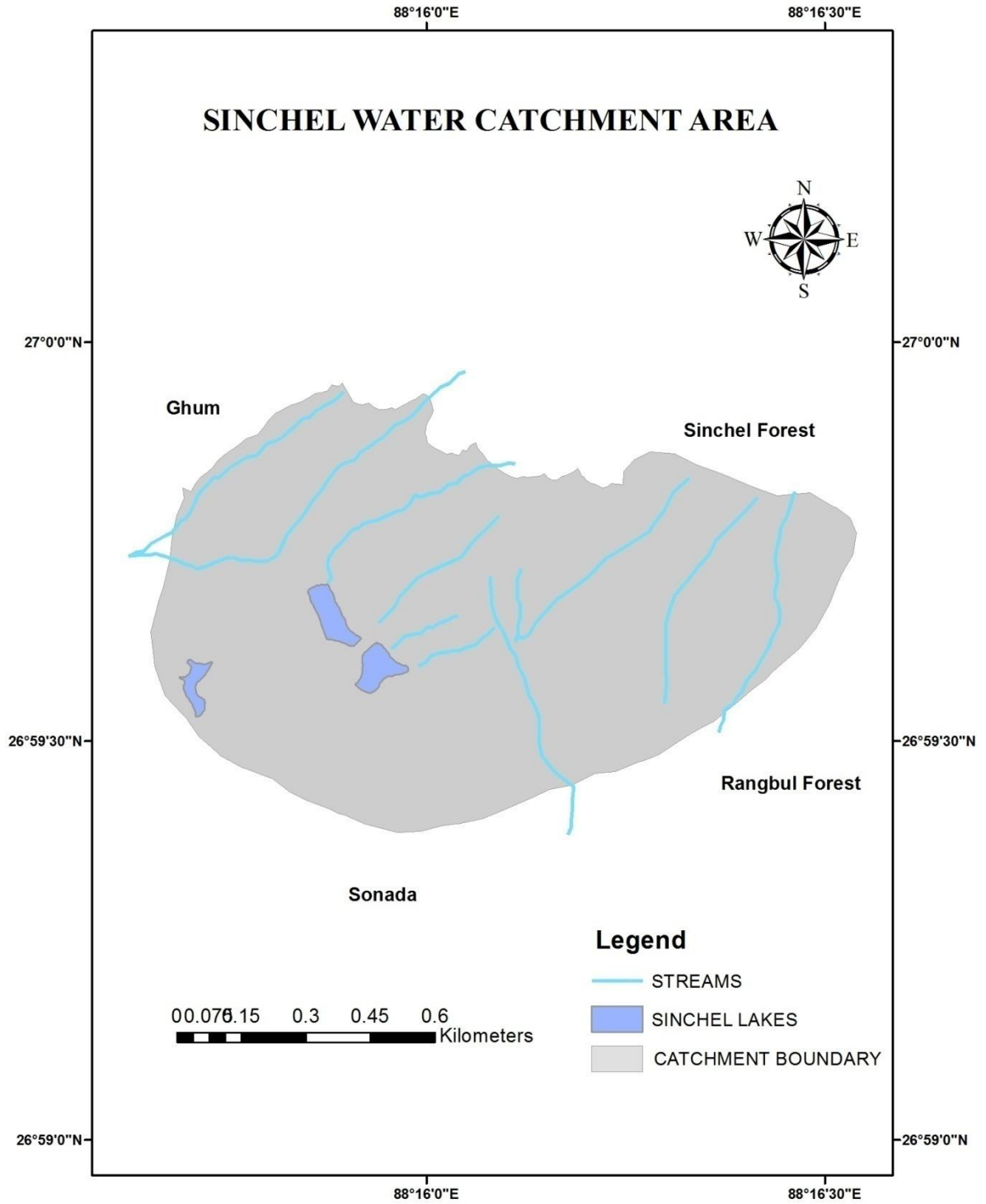
Sinchel Range is located at 10.5 km south east of Darjeeling at an elevation of 7000 to 8000 ft (2134 to 2438 meter) above the sea level. In 1940 this area was declared as a “Sanctuary” by the British East India Company and is one of the oldest wildlife sanctuaries of India (Rasaily, 2014). The sanctuary is surrounded by tea estates and khasmal (grazing) lands. Jorebunglow-kalimpong road passes through the northern side of the sanctuary and on the South and Eastern part of the sanctuary passes Kurseong –

Darjeeling roads and the railway line. To the South there lies the old Darjeeling – Kalimpong military road.

Spreading in an area of 3860 hectare this sanctuary is a home to some of the exotic Himalayan flora and fauna which are indigenous to the region. High-altitude animals such as barking deer, wild pig, Himalayan black bear, leopard, jungle cat, common rhesus monkey, Assam macaque, Himalayan flying squirrel, etc. are found in their natural habitats. Sinchel range has moist temperate type of vegetation. The sanctuary also forms the catchment area that provides water to the town. The sanctuary not only provides the habitat for the animals but also is the major source of water supply for people of Darjeeling town, surrounding villages, tea gardens and Mangpoo-Cinchona plantation area. Therefore, Sinchel range acts as an important “life line” of water supply for the people of Darjeeling and villages located in its geographical milieu.

This sanctuary covers an area of 3860 hectare out of which the catchment area covers 1060 hectare (Rasaily, 2014). At present 26 numbers of springs emerges from the northern and the southern part of Sinchel Range. Water from these springs are collected in an arrestor tank and is fed to the Masonry conduit line (which is about 8 km in length) that bring water on gravity to the ground storage reservoir namely North Sinchel Lake and South Sinchel Lake. To monitor the nature and pattern of discharge of each of these springs Darjeeling Municipality water work department has given number to each of these springs. Accordingly spring number 1 to 4 falls between Jorbonglow and North Lake and springs number 5 to 22 lies between South Sinchel Lake and Kong Khola. The masonry conduit line is the only system that collects water from all the perennial springs and drains it to the twin Sinchel Lake. The town mostly depends on these two lakes namely North Sinchel Lake and South Sinchel Lake for the water supply. These lakes were constructed during the British regime for providing sufficient amount of water to the small number of population that thrived in the region during that period of time.

Figure 5: Sinchel Catchment Area



Source: Adopted from Google Earth, December 2014

3.2.1. North Sinchel Lake and South Sinchel Lake

These lakes are of vital importance for municipal water supply in the town. The North Sinchel Lake was constructed in 1910 and is located at an altitude of 7444.50 ft above the sea level. The lake is 25 ft 6 inch deep and it has a capacity of holding 20 million gallons of water (Annual Report, 2010). The South Sinchel Lake was constructed in 1932 and has a capacity of holding 13.5 million gallons of water. The South Lake has a depth of 22 ft.

The discharge of water through the open conduit, conveying water from the 26 springs located within the Sinchel range feed both these lakes. According to the Darjeeling Municipality report, (2010) the average discharge of water through the open conduit is 14000 gallons per hour i.e. 3.36 lakh gallon per day during the lean period and during the non lean period the average discharge through the open conduit is 80,000 gallons per hour and 19.2 lakh gallons per day.

The inflow of water from the springs of Sinchel range has been gradually decreasing at an alarming rate in the recent times, mainly due to massive illegal felling of trees in and around the sources. In 1984 out of 3860 hectare of the total area approximately 770 hectare (18 percent) of the area was completely deforested and it was increased to about 50 percent by 1986. The degradation of Sinchel natural resource has a great impact on water harvesting capacity and water supply to Darjeeling. The rapid deforestation has led to denudation of the hills resulting in increase in runoff and decrease in percolation of water. This percolation of water is essential for release of underground water in the dry season. The denudation of the hills has also resulted in the decrease of rainfall during the non- monsoon months as a result of which conduit discharge has shown a downward trend and this has become one of the serious reasons for the shortage of water in Darjeeling today.

Plate 1: North and South Sinchel Lakes



South Sinchel Lake

North Sinchel Lake

Photo: Suvechha Ghatani, December 2014

3.2.2. Sindhap Lake

Sindhap Lake is the other important source that provides water for the town. This lake is also located within the Sinchel range. During 1970's the population of Darjeeling increased to 42,873 from 33,605 in 1951 and during the tourist season and with the opening of schools and colleges another 15,000 to 20,000 of population was added in the town (Rasaily, 2014). This led to serious impact on the available water resource of the town and it became difficult to cater the demand. So, in order to cope up with the problem the third lake named Sindhap Lake was constructed by PHE (Public Health Engineering) Department in the year 1978.

This lake had the capacity of holding 15 million gallon of water, but due to the poor quality of reservoir and several leakages Sindhap Lake fails to provide the satisfactory result. According to municipality report Sindhap Lake today can store only 50 percent of the water of its actual capacity. Water in this lake is mainly pumped from Bangla khola and Khong khola located very close to the lake and also from the perennial springs located around the lake. The lake helps to provide additional water to the twin Sinchel Lake during dry period. The main aim of this lake is to store water from different

sources during the lean period and provide water to the twin Sinchel Lake during the dry period. The Sindhap Lake is usually operated only during the dry period.

Plate 2: Sindhap Lake



Photo: Suvechha Ghatani, December 2014

3.3. Khong Khola

Khong Khola is a small perennial river near the town of Darjeeling. During dry season when the yields of springs are not sufficient to fill up the lakes to meet the demand of the people in the town, water is often pumped from Khong Khola. According to the Municipality Report (2010) about 75,000 gallons of water is pumped per day from the Khong Khola to Sinchel Lake.

Plate 3: Khong Khola



Photo: Suvechha Ghatani, December 2014

3.4. Rambhi Catchment Area

Apart from the three Lakes located in the Sinchel catchment area, water from the Rambhi catchment area is also the other important source through which water is supplied to the town. It is located about 20 km away from Darjeeling Town. Rambhi catchment area consist of streams like Rambhi khola, Kalikhola and eleven number of natural springs that helps to provide water to the town during lean period. Water from these springs are accumulated and collected in a cast iron pipe that ultimately reaches the Jorbunglow filter house. The main transmission line stretches to 10 km in length from Rambhi source to Jorbunglow filter house. According to Municipal Report (2010) this catchment area has a total yield capacity of 1, 50,000 gallons of water per day. Sometimes during the peak water scarcity period Municipality collects water in a taker and trucks from these streams and supplies it to the town to cater the demand of the town.

Comprehensive water supply schemes from Rambhi catchment area was planned and implemented by PHE and Darjeeling Municipality in order to facilitate the increasing demand of water in the Town. The first water supply scheme from Rambhi catchment area was initiated during 1969 -72 by PHE Department; as it failed to give the satisfactory result the second phase of the scheme named as “*Darjeeling Water Supply Improvement Scheme*” was initiated by Darjeeling Municipality (which was later taken by PHE) in 1993 (Rasaily, 2014). Though this scheme was somehow completed but it could not come out with the satisfactory result due to various technical problems. The estimated pumping of water from the Rambhi catchment to the Jorbonglow filter house was 2 lakh gallons per day but actually it was successful in pumping only 70 to 80 gallons of water per day. At present about 60 percent of the water from Rambhi is mainly distributed to Army cantonment area and the rest is used by Darjeeling Municipality. Thus Rambhi catchment area can be termed as the other major lifeline for the people of Darjeeling that helps with additional supply to the people.

Plate 4: Spring in Rambhi Catchment Area (Tintaley Dhara)



Photo: Suvechha Ghatani, December 2014

3.5. Natural Springs Located within the Municipal Area

Apart from municipal water supply through pipelines, natural springs located within the town area are also the other major source of water for the town. Darjeeling town is endowed with good number of perennial and semi perennial natural springs due to its higher relief and steeper gradient. Some parts of Darjeeling town, especially the urban periphery lack access to the municipal water supply system and are entirely dependent on the spring water for their existence. There are more than 32 numbers of natural springs available within Darjeeling municipal area (Joshi et.al, 2011). These springs at an average serves about 20,000 gallons of water per day (Rasaily, 2014). Although these perennial springs are located within the municipal boundaries they are yet not within the responsibilities of the municipality.

However most of these springs are managed by the communities or *Samaj* (local club) located in and around the area. These *Samaj* takes the responsibility of management and maintenance of the springs and also fix the capacity or the average volume of water, the people can draw from the spring so that equal volume of water can be distributed to all especially during the dry seasons when the volume of water decreases drastically. Religions and social group also plays an important role in the cleanliness and protection

of the springs. A brief study on some of the springs located within the municipal area is presented below:

3.5.1. Giridhara

Giridhara is the name given to the spring located in ward number 17 below the Darjeeling railway station. The surrounding village within this spring is called Belomber estate (Joshi et. al, 2011). Water in this spring (Giridhara) never dries off even during the dry season. Apart from the municipal water supply, most people of Belomber estate depends on this spring for water supply. People residing around Railway Station, R.N Sinha Road, Ladenla Road are also benefitted by this *Dhara*. The construction of the spring and the land on which the spring is located are in the possession of one family. The first construction of this spring had taken place in 1955 by Hasta Lal Giri, after which the spring was named, since then the spring construction and the landownership has remained in the possession of Giri family.

According to Municipal data, 285 people lived within ward number 17 in 2001. The number of people depending on the spring living in Belomber estate was estimated to be 800, when adding the water users from the surrounding village the total amount of people depending on the spring is increased to 3000 (Joshi et. al, 2011). The number of people depending on water from this spring increases mainly during the lean season.

The responsibility of management and maintenance of the springs has always been done by Giri family. Usually the spring is accessible to all the users throughout the year but, during the lean season when the volume of water in the spring decreases certain rules and regulations are maintained. Rules like when the water is extremely scarce outsiders are not allowed to fetch the water, there are restrictions on bathing during the lean season, washing clothes are not allowed for the outsiders, selling of water from this springs are not allowed both during the lean and non lean seasons.

There is no provision for the storage of water or to lock the water taps. Since, the water in this spring never dries off; the outflow of water takes place for twenty four hours a day. Therefore, there is heavy loss of water especially during the monsoon seasons and during the night hours. According to information obtained from the municipality, the

storage tank with the capacity of 20,000 liters was installed to store some of these losses and water from this tank is supplied to the villages located downhill. Apart from the loss of unused water there is also underground seepage of water.

3.5.2. Laldhikhi

Laldhiki is the other important natural springs located at Dr. Yen Singh Road in ward number 22. The spring is named after the surrounding village Laldhiki. It is located in middle of market area. The flow of water from the spring is high and also it never dries off. The first spring construction was built in 1932 by local contractor named Gokul Lama for the social purpose (Joshi et.al, 2011). This village is mainly considered as slum area by Darjeeling municipality.

The spring is mainly used by the people living in the upper half of the town area of Darjeeling, mostly from the villages like Chandmari, Ghadi khan, Alice Villa, M.C Building, Rai Building, Ede village, Lower Chowrasta, Kutchery road, Chok bazaar, and GDNS (Gorkha Dukha Niwark Samity). These villages lies within ward number 19, 20, 21, 22, 23, 25 and 30. After the construction of spring in 1932 no one claimed for the responsibility of managing the spring and the area was very much neglected. It was in 2006 that *Laldikhi Ekta Samaj* was formed and an office was built on top of the spring and started to take care of the spring. The spring has one 500 liter collecting tank and two water taps (Joshi et.al, 2011). There is no storage tank and no facility of storing the water hence high amount of water is lost during non lean period and during the night hours. The spring is freely assessable to all the users, selling of water is also allowed from the spring. Large number of water vendors uses water from this spring for selling purpose by carrying water in jerry cans. Usually washing is not allowed in this spring. The Lal dhiki Samaj estimated the number of water users from this spring to be about 15,000 people (Joshi et. al, 2011).

The environment of the spring is very detrimental. Large numbers of constructions are taking place uphill and around the spring site. Some jewelry shops are located uphill the springs and the chemicals used by them are thrown into the garbage ditch that runs just along the spring side. Over the last 20 years several large landslides occurred within the spring site area (Joshi, et. al, 2011). According to *Samaj*, in 2007

there was a large landslide uphill from the spring and the colour of the water turned white. This was caused due to the particles dissolved into the spring source and breaking of the sewerage pipe just above the spring.

According to the water users, the supply of the spring has decreased as compared to the last 5 to 6 years and the flow of the spring decreases to 50 percent during the lean season. The main reason behind it is the large number of construction taking place uphill the spring.

3.5.3. Kholi Ghar

Kholi Ghar spring is situated within the Frymal village in ward number 27. This area is considered as slum area by the municipality. Beside the residents of Frymal village, people from the two surrounding villages namely Bhanu Gram and Bons Gram also depend on this spring. The local *Samaj*, Frymal Sudhar Samiti estimated the number of people using this spring is approximately 3000. Maintenance and management of the spring is usually done in collaboration with the Frymal Sudhar Samiti and the *Samaj* of the neighboring villages. According to the users no support has been received from the municipality or any other organizations till today regarding the maintenance of the spring till date. At the spring site there are three water taps and all these taps can be locked due to which the wastage of water can be checked.

Though the springs are openly accessible, certain rules and regulations are implemented during the period of scarcity like particular time period is fixed for the supply of water and outside the time the water taps are locked. Waters users get water via jerry scan queue distribution and the particular limits are fixed to maintain the equal distribution of water. According to the users they are allowed to fetch 60 liters of water at time. The flow of spring has been decreased over last 5 to 8 years and the spring flow drops annually to 50 percent during the lean season.

3.5.4. Jail Dhara

Jail *dhara* is located in ward number 18 near Darjeeling State Prison. This spring was built about 60 years ago to provide water to the Darjeeling State Prison (Joshi et al. 2011). This spring apart from providing water to the Jail is also openly assessable. The

surrounding village called Tangluview village depends on this spring. Especially during the lean period people from the surrounding villages like Haridas Hatta, Patri *Kaman*, Pragati Gram, Chandmari, Bhutia Busti, Thana line, Gaddikhan, Manthulal, Sv. Nivedita Gram depends on this spring for water supply. According to the users the number of people depending on the *Jail dhara* has doubled over the last 20 years.

The land on which the spring is located is owned by jail, so the control over the spring is still with the government. When the maintenance is necessary people of *Gaon Samaj* has to meet the PWD and Jail officials. Due to lack of storage tanks there is no facility to lock the water taps due to which large volume of water is lost during the night hours and during the non lean seasons. Apart from loss of unused water there is also underground seepage caused due to large number of constructions taking place uphill. Nearby the spring is *Jhora* and water seepage from this *Jhora* usually takes place and there is a risk of contamination of spring water. Water is openly assessable to all the users but during the lean season conflicts occurs among the users. According to the users the spring flow has decreased to over the last 5 to 8 years and the spring flow drops annually to 50 percent during the lean season.

3.5.5. Police Dhara

The Police *Dhara* spring is located at the lower part of the Darjeeling town. Like Giridhara, Police *Dhara* is also located within the ward number 17. Its surrounding village is called Mangal- Puri and is one of the newly developed village of Darjeeling. The village receives no municipal water supply and is totally dependent on the spring for the water supply. The land on which the spring construction are built is donated by Mr. Maui Kumar one of the prominent member of the *Samaj*.

The management and maintenance of the spring is the responsibility of the Mangalpui *Samaj*. The first spring construction was made in 1992 by the *Samaj* with the help of PHE (Public Health Engineering) Department. Due to high elevation of the spring site villagers built a desilting tank with the capacity of 2700 liters, pressure tank with the capacity of 14500 liters and a pumping house to pump water uphill for effortless distribution (Joshi et. al, 2011). The *Samaj* has appointed a water committee that looks after the management of the spring.

The water committee along with the two permanent staffs organizes water distribution and occasional maintenance. Each households pays Rs 100 as a contribution to the *Samaj* for the expenses of supply such as electricity, maintenance and salary of the staffs. One storage tank and two distribution tanks were built by the *Samaj* uphill and according to the villagers these storage tanks has sufficient storage capacity to supply water year round to the village. Even at the lean season the spring flow is larger than the demand of the village. The distribution of water is done more uphill through distribution tanks. The distribution of water is fixed, every alternative day households receives 100 liters of water. The water is distributed three times a week at the different distribution points and the appointed staffs takes care of the distribution and pumping of water from the spring to the distribution tanks. The area of the spring is protected by the *Samaj* and no human activity is allowed within the spring site as a result of this according to the users no decrease in the spring flow has been noticed part from slight decrease during the lean season.

Beside this there are many other springs (*dharas*) located within the town like Haridass Hatta Dhara, Bhotey Dhara, Batasia Dhara, Vineeta Gram etc. that helps in providing water to the people residing in and around the town .

Table 11: Location of Natural Springs within Municipal Area

Springs	Latitude	Longitude	Elevation
Bhotae Dhara	N27° 03.363'	E 88° 15.061'	1897M
Kholi Ghar	N27° 03.263'	E88° 15.259'	1911M
Haridas Hatta	N27° 02.866'	E88° 15.685'	1947M
Lal Dhiki	N27° 02.696'	E88° 16.025'	2035M
Muldhara	N27° 02.665'	E88° 16.176'	1911M
Jail Dhara	N 27° 02.534'	E88° 15.675'	1908M
Dara Gaon	N27° 02.281'	E88° 16.072'	2055M
Giri Dhara	N27° 02.267'	E88° 15.740'	2006M
Police Dhara	N 27° 02.231'	E88° 15.486'	1869 M
Vineeta Gram	N27° 01.886	E 88° 15.794'	2157M

Source: Joshi, et.al, 2011, P 36

Table 12: Major Sources of Water available for Darjeeling Town

Intake of Water	Capacity (Gallons/ Day)
Reservoir of Sinchel lakes	3,36,000
Pump from Khong khola	75,000
Springs from Rambh catchment area	1,50,000
Boxi Jhora	12,000
Laldhiki, Bhyaguldhara, Bhotedhara, Giridhara Springs	20,000
Total	6,17,000

Source: Rasaily, 2014, P 89.

3.6. Conclusion

Darjeeling has umpteen water resources in the form of rivers, streams, jhoras and natural springs located within the town and in its immediate surroundings. It can be clearly understood from the above study that there are adequate number of water resource available in Darjeeling to meet the everyday demand of people. Darjeeling being one of the high rainfall area with the region receiving the highest annual rainfall among the rates in India and due to its higher relief and steeper gradient ground water gushes out in the form springs.

The large number of the available water resources has been severely affected in the recent decade by rapid urbanization, deforestation in the catchment area and sources of water, large number of constructions taking place in the rapid manner ultimately leading to extreme water scarcity in the town. Apart from the natural calamities that threat the environment, increase in the number of human activities has added more problems to the environment of Darjeeling hill ultimately leading to problems like water scarcity. In spite of the presence of sufficient number of 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.

Plate 5: Springs Located within the Municipal Area



Laldikhi Dhara



Police Dhara



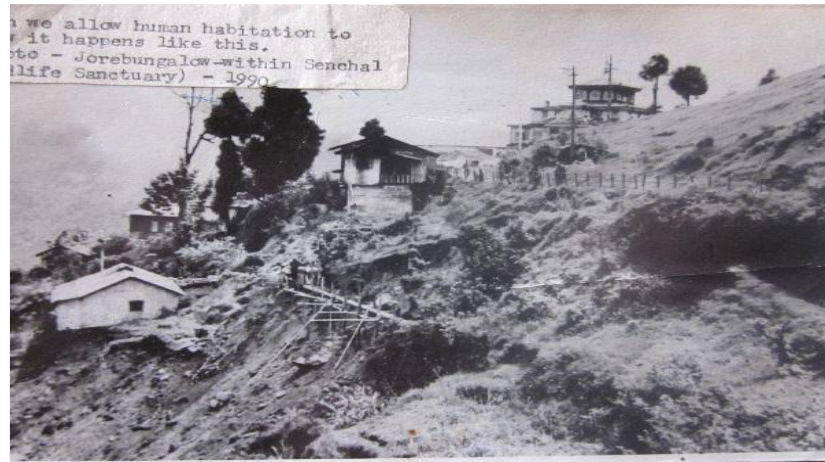
Kholi Ghar



Muldhara

Photo: Suvechha Ghatani, December 2014

Plate 6: Deforestation in Sinchel Area



Source: Rasaily, 2014, Pp 155-56

CHAPTER 4

WATER GOVERNANCE AND MANAGEMENT: ROLE OF PUBLIC AND PRIVATE SECTORS IN WATER SERVICE

4.1. Introduction

Governance broadly refers to the structures and processes for social coordination and collective decision making (Rogers and Hall, 2003). It primarily deals with the roles and activities of various actors and institutions and interactions among them, in terms of their collective influence and development of Socio-Ecological system. Global Water Partnership (GWP) defines water governance as “range of political, social, economic and administrative system that are in place to develop and manage water resources and delivery of water services, at the different levels of society (GWP, 2000).

The increasing pressure on freshwater resources resulting due to increased supply-demand challenges posed by population growth, rapid urbanization and climate change has led to the critical need for improved water governance in the recent decade. Good governance on water resource is necessary as it allows for enhanced sustainable use of water and also ecosystem integrity. Effective water governance is characterized by participation transparency, equity, accountability, coherent, responsiveness, ethical choices and sustainability (see appendix A) (de Loe and Kreutzwiser, 2007).

The concept of water governance refers to the decision making process which influence the adoption of operational approaches to initiate management (Bakker and Cook, 2011). Though “water governance” and “water management” are interrelated but differs in that “water governance” refers to the process in which the decisions are made and who are involved in this decision. “Water management” refers to those prepared approaches we adopt and the models and principles and information we use to make this decision (Bakker and Cook, 2011). Efficient water governance is one of the major pillar of effective water resource management that ensures equitable sharing, efficient use of water and also leads to environmental sustainability (Rogers and Hall, 2003).

Several social institutions are engaged relating to management and allocation of water service in case of Darjeeling. Darjeeling Municipality is mainly responsible for the municipal water supply infrastructure and management. It is also the responsibility of municipality for the management of springs located in the Sinchel Wildlife Sanctuary, which is the major source for the water supply in the town. The community based organization, also known as *Gaon Samaj* manage most of the springs located within the town. Although the perennial springs are situated within the municipality boundaries, they are yet not within the responsibility of the municipality. It is mainly the *Gown Samaj* that is responsible for the management of these springs. And the third group is the local water sellers (private water vendors), they play a very important role in the recent date in the supply of water to the people of Darjeeling.

4.2. Role of Municipality in Water Supply Service

4.2.1. Institutional Framework

Darjeeling Municipality was established on 1st July 1850 and is considered as one of the oldest city administrative body of the country. The municipality is mainly responsible for the civic administration of the town of Darjeeling; one of the important civic amenities provided by Darjeeling Municipality is the supply of drinking water. Generally, the responsibility of municipality over the distribution of water is very rare in the state West Bengal, the water supply on the other municipal areas in West Bengal is managed by Public Health Engineering (PHE) department of government of West Bengal. Darjeeling municipality is the only municipality that has been managing water supply on its own starting from augmentation up to the distribution level without any specific budgetary provision from the government (Joshi et. al, 2011).

At the municipal level, the official planning and execution of supply and management of water resource for Darjeeling town is based on the hierarchical system. Darjeeling municipality depends on its own source of revenue for sustenance. However, it receives additional funding from the state government for various projects under special allocations. Thus municipal revenue is the primary means to sustain municipal operations. The important source of municipality for financing the urban development

projects is through the revenue generated from different local sources including local taxes and service charges. The overall decisions regarding water supply and water resource management are made by the chairman and are passed on to the water work department where it is assisted by Assistant Engineers. Water work department of Darjeeling municipality consists of Assistant Engineers and Sub assistant engineer who takes care of the departmental repair and construction. Under them, there are a team of waterworks inspectors and 67 number of staff which include valve man, majdoors, sardar mistri (mason), lower division clerks (LDC), upper division clerks (UDC), peons and guards¹¹.

Darjeeling municipality water works department faces several constraints for proper sustaining and delivery of water. In the response to the question regarding the most pressing problem faced by the department regarding proper management of water in the town, the key informant of the department remarked:

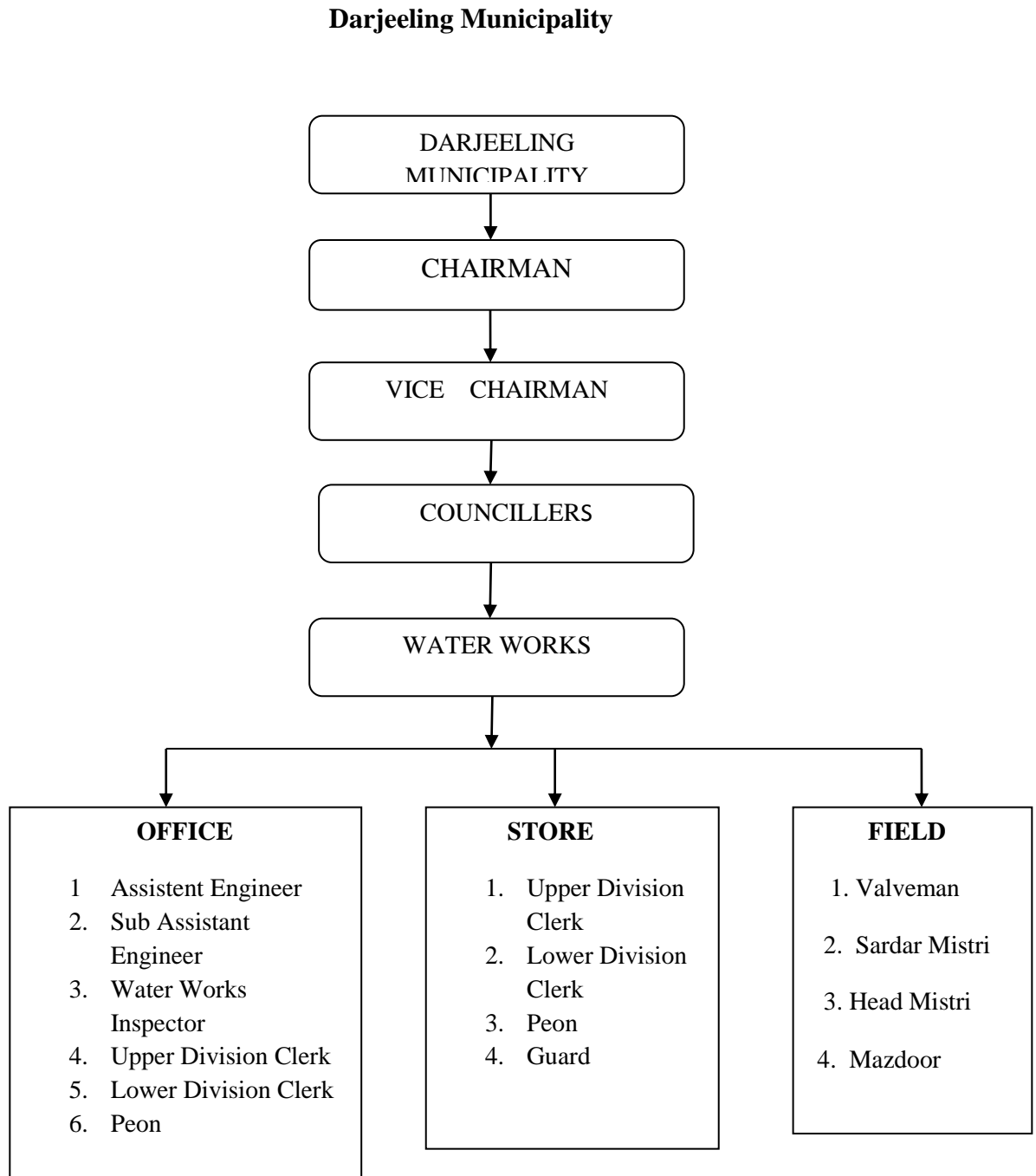
“...There are number of challenges faced by the department regarding water management but talking about the major challenges, one of the major challenges faced is, the department has insufficient and unqualified personals for the efficient management and governance. Most of the workers do not have appropriate education and training in water supply and service delivery. Other major challenge faced by the waterworks department regarding rendering effective service is shortage of revenue to cover the required expenditure shortfall and finance the expansion of piped water facilities”.

According to him, revenue is the major means that facilitates water supply operation, maintenance and expansion for the new establishments. Thus, the important source of revenue for financing the water supply service is mainly generated from water sales and service charges. At the same time the taxes collected are very low and are insufficient to meet the actual needs. Moreover, they are not collected at a satisfactory rate. Delivery of suitable urban water supply requires large number of investment.

¹¹ It has been written on the basis on the information given by Assistant Engineer, water works Darjeeling municipality during the interview schedule.

Collection of revenue at such lower amount also hampers in the smooth functioning of the system.

Figure 6: Organizational Chart of Water Works Department



Source: Darjeeling Municipality Office, September 2014

4.2.2. Water Distribution Network in Darjeeling Municipal Town

The whole distribution system of water in Darjeeling town is made under the jurisdiction of Darjeeling municipality. The distribution of water in the municipal area is done through the networks of tanks and the pipe lines distributed all over the town and also through operating the valves located at different places over the town. Many areas in the town will not get the water if the valve is not opened in the synchronized manner by valve-man at different places, thus valve man also plays an important role on the proper distribution of water in the town. During the dry season when the volume of water decreases water is also distributed through tanker by municipality to the people in the town.

Darjeeling town water supply system consists of about 35 km transmission main, 83 km of distribution main lines (excluding the service line and public hydrants), 14 pipeline bridges along transmission mains and 90 valves scattered all over the town (Annual Report, 2010). Water that has been collected in the Sinchel Lake through tapping of water from different springs flows with the gravity to the filter house located at Jorbonglow with the help of 10” and 8” pipe lines. Water from the Rambh catchment area also enters the filter house through the main transmission line which stretches to the length of 10 km. The water is treated with the help of sand filtration plant located at Jorbonglow. Water filtration is done through five pressure filters each having the capacity to filter 16,000 gallons of water per hour. The rapid sand filters use relatively coarse sand and other granular media to remove particles and impurities that have been trapped in the floc¹² through the use of flocculation chemicals mainly salt of aluminum or iron. Water and flocs flows through the filter medium under pressure and the flocculated material and trapped in the sand matrix.

From the filter house water is then transmitted with the help of large water mains to the two storage reservoirs situated at St. Paul (Saint Paul Storage tank) having the capacity of 2, 35,812 gallons and Rock Vail (Rock Vail Storage tank) one having the capacity of 56,651 gallons and other having the capacity of 58012 gallon. The

¹² Floc is a small, loosely aggregated mass of flocculent material suspended in a liquid. It consists of finely divided suspended particles and it helps to remove impurities from water during water clarification.

transmission of water from the filter house to the Rock Vail storage tank is done through CI (Cast Iron) pipe with the diameter of 200 mm and 150 mm each stretching the length of 4344 m and transmission to the Saint Paul storage tank is made through the CI (Cast Iron) pipe of 200 mm diameter and it stretches to the length of 3379 m (Annual Report, 2010).

Water from these reservoirs is then distributed to the residents of different wards either directly through the reservoirs or through the subsidiary tanks distributed at the different places of the town. There are twenty seven distribution main and subsidiary tanks that receive water from the Saint Paul storage tank. From the Rock Vail tank water is supplied to thirty nine distribution main and subsidiary tanks.

The existing water supply infrastructure was installed during the first quarter of 20th century to cater the demand of small population during that period of time and the civic amenities and infrastructure were installed accordingly. In the recent time this civic amenities and the infrastructure is supporting the population of 1, 20,414 (Census of India, 2011). About 95 percent of the pipelines and the valves were laid during the introduction of water supply system in Darjeeling. Due to this the pipelines and valves have become old and dilapidated. Very little work has been done till date for the replacement and restoration of these old pipelines, as a result of this large volume of water are wasted due to leakage of pipelines and valves adversely affecting the general water supply. Further illegal tapping of water and unscientific connections have added much more problems to the existing distribution system ultimately leading to scarcity of water in the town. Water is also supplied through water tanker trucks by the municipality during the dry season to cater the need of people.

Table 13: Source of Water for Municipal Water Supply

Source	Gallons/day
Springs from Sinchel range	1,44,000
Pump from Khong Khola	75,000
Sindhap Lake	1,00,000
Springs Rambh Catchment area	1,50,000
Boxi Jhora	12,000

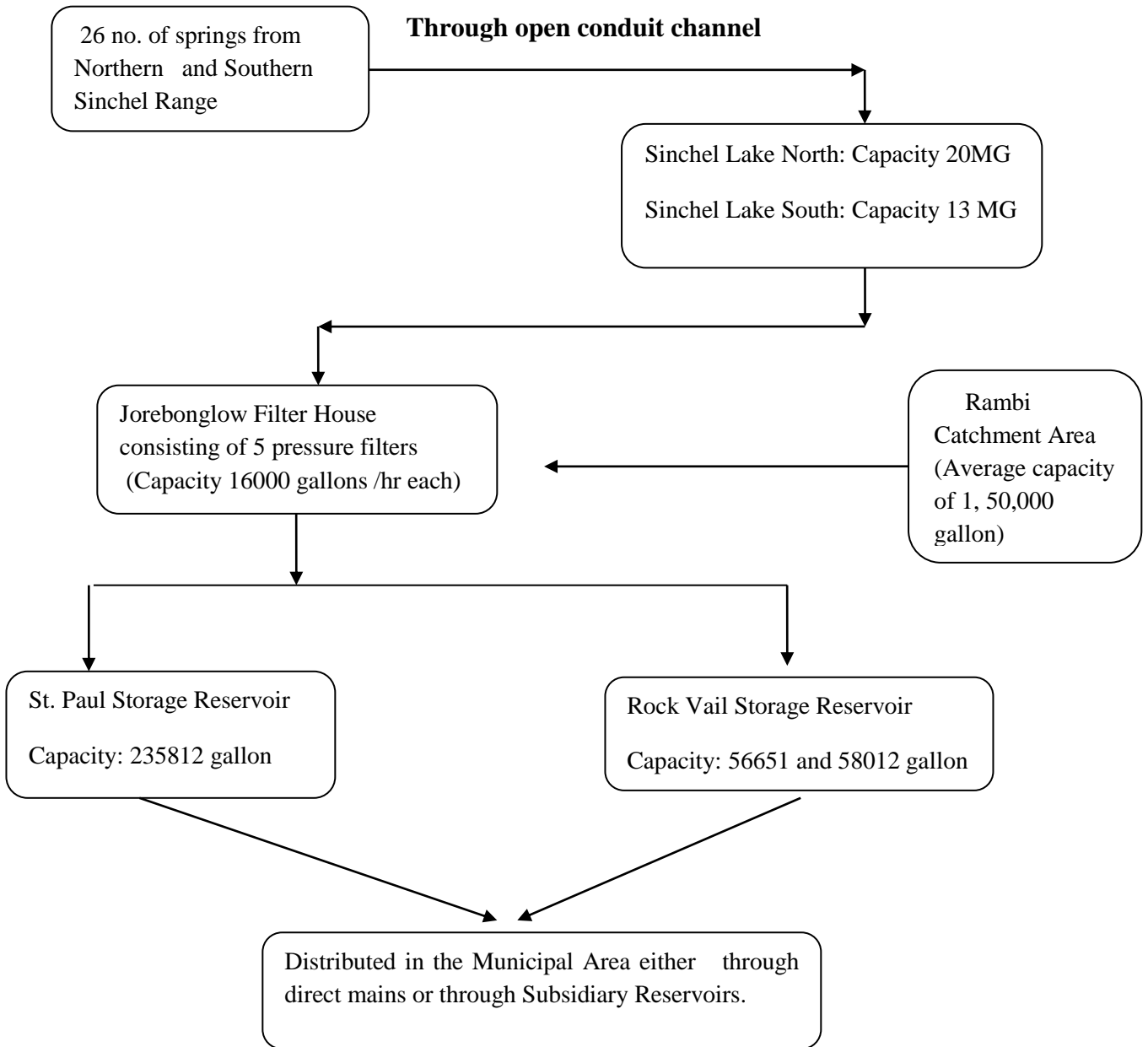
Source: Rasaily, 2014, P 89

Table 14: Storage Reservoirs and Distribution Reservoirs for Water Supply in Darjeeling Municipal Area

Sl. No	Storage Reservoir	Capacity (Million Gallons)
1	North Sinchel Lake	20
2	South Sinchel Lake	13.5
3	Sindhap Lake	14.0
	Total	47.5
	Distribution Tank	Capacity (Gallons)
1	St.Paul Storage Tank	2,35,812
2	Rock Vail Tank Iron	56,651
3	Rock Vail Tank Masonary	58,012

Source: Darjeeling Municipality Office, July 2014

Figure 7: Existing Water Distribution Network of Darjeeling Municipal Town



Source: Darjeeling Municipality Office, July 2014

4.2.3. Nature and Pattern of Water Demand and Supply

Darjeeling municipality takes the responsibility of providing water to the large section of people residing in almost all the municipal wards. The drinking water needs to the majority of population in the study are fulfilled by them through piped water supply. Water is even supplied through tankers during the dry seasons when the volume of water gets lowered. The water supply connects 51 percent of the municipal households. However, the quantity of water supplied is limited and highly irregular.

Table 15: Calculation of average water supply and demand in the town

Parameters	Gallons/day
Total Water Storage Capacity of Reservoir (N.Sinchel lake, S.Sinchel Lake, Sindhap lake)	4.75 million gallon
Water Production Per day	8,50,000gallons/day
Wastage (25%)	2,12,500 gallons/day
Net water available	6,37500 gallons/day
Fixed Supply (Army, Hospital, St. Paul School)	11,000 gallons/day
Water Available for Public	5,27500 gallons/day
Total Demand of water	3,564,000 gallons/day
Total Water Available	5,27500 gallons/day
Total Deficit	3,036,500 gallons/day

Source: Annual Report, 2010, Darjeeling Municipality

Darjeeling town presently supports the population of 1, 20,414 people (Census of India, 2011). According to the government of India's norm 135 lpcd (liter per capita per day) of water is needed for urban residents, as per this standard Darjeeling town needs 16255890 lpcd of water. The demand of water will be further increased during the tourist season with the increase in the influx of tourists. The municipal data reveals that the total demand of water in the town is 3564000 gallons/day while the total supply from the available resource is 527500 gallons/day as a result of this 3036500 gallons of water is found to be deficit in Darjeeling municipal town at present. Therefore, the intensity of

shortage of water is high in case of Darjeeling. World Business Council for Sustainable Development (2005) mentions the availability of countries freshwater should be at least 1700 m³ for it to be sufficient. If the value falls between 1000 to 1700 m³ the country experiences water stress, while if the value falls below 1000 m³ the value than the country will experience water scarcity

The town of Darjeeling has relatively developed in the present times with large number of multiplexes and shopping malls displaying weighty brand names. Further, the rate of urbanization and increase in population has been at a faster rate. However, the supply of water has not increased at the required pace. The available water supply system has failed to provide sufficient water to the town. The supply of water from the existing water system is lesser as compared to the demand. The rate of water supply is grossly inadequate and very far from the civic norm of 135 lpcd. The increasing demand on one hand and the deteriorating condition of supply on the other hand has increased the gap between the demand and supply of water and thus the intensity of shortage goes on increasing at a faster rate leading the town to scarcity of water.

As per the information of municipal official, Darjeeling town has the shortage of reservoirs. During rainy season the collection of water at Sinchel Catchments area becomes sufficient from eight to ten springs. The rest of the springs have to be cut off due to limited capacity of reservoirs at Sinchel. Thus, million gallons of water are wasted due to insufficient number of reservoirs.

4.2.4. Balasun River Project

Keeping in view the problems relating to water scarcity in Darjeeling town and to meet the shortage of water of Darjeeling Municipality, PHE (Public Health Engineering) department, Government of West Bengal has recently taken up a surface water supply project at river Balasun called “Balasun River Project”. River Balasun is located at the junction of Rangmuk and Ceder Tea Estates, approximately 13 km away from Sinchel Lake. Balasun River Project is one of the high budget project funded by government of West Bengal with the total cost of Rs 55.86 crore. Balasun Project was first mooted in early 1990’s to relieve Darjeeling of its water scarcity. The foundation stone of the

project was laid on 19th February 2006 by Buddhadeb Bhattacharjee, the then Chief Minister of West Bengal.

According to the project, raw water from river Balasun would be pumped to the Sinchel Lake located at an altitude 2270 m by relay system through two pumping stations, one located at Balasun and other at College Valley. The settled water from Sinchel Lake will be send to Sindhap Lake through gravity where it will be treated in a battery of pressure filters. The treated water will be supplied to municipality at their storage reservoirs located at St. Paul and Rock Vaile through 225 m main line pipes running through Jalapahar Cantonment area, from this reservoir the municipality will supply water to the citizens through their own pipeline distribution system. The project has been envisaged to supply 2 million gallon of water per day to Darjeeling from Balasun River.

The project was supposed to be completed by 2009. However it is still a distant dream. The project witnessed stoppage several times for various reasons. According to the report of PHED that is responsible for supervising the project, 80 percent of work of the project has been completed. The civil work is almost done and only the completion of the mechanical work is required. The civic bodies aimed at improving the conditions regarding water scarcity of Darjeeling with this project. The Balasun project has given a ray of hope to the people of Darjeeling regarding solution of water scarcity in the town.

Besides Balasun River Project, seven other big and small water supply schemes and projects have been undertaken by the state government between 1962 and 2001 in Darjeeling with the aim to meet the demand of water in Darjeeling. Out of seven water projects, only one which is known as Boksi Jhora project has been fully successful in giving the fruitful result. Other projects like Rambhi Khola water Project whose foundation was laid by Sir Joti Basu in 1995 could not come out with the successful result. Similarly Rungdung Khola Water Project, Khong Khola Water Project, Sinchel Lake and distribution System Renovation Project were some of the projects that were planned to solve the problem of scarcity but were totally unsuccessful.

4.3. Role of Private Players in Water Supply Service

An increasing gap between the demand and supply of water and subsequent failure of the planned efforts by the Municipal Water Supply Infrastructure (MWSI) and government to meet the basic needs of water has added much more to the sorrow of the people of Darjeeling. Such a chaotic situation has in turn led to emergence of private entrepreneurs in making business of it. Due to high paucity of water, selling of water has become a profitable business in Darjeeling today. Water vendors are commonly seen in the study area (Darjeeling town) operating without any legal framework. Water business has added an employment opportunity to many unemployed youths in Darjeeling as this has become one of the easiest mode of earning. Insufficient and unreliable supply by the MWSI to meet the demand of water in the town have compelled the people of Darjeeling to choose the only alternative source of drinking water available, which is private suppliers, to meet the need.

Out of the total sample consumers (domestic, commercial and institutional consumers) selected for the study, 83 percent of the domestic consumers, 87 percent of commercial consumers and 80 percent of institutional consumers depend on private water vendor apart from municipal water supply. The survey analysis reveals that on an average 83.3 percent of consumers depends on private vendors for the need of water. The private water vendors play a very important role when it comes to meet the need of water, mainly during the dry seasons when the scarcity of water goes up. Therefore, during the dry season when the supply of water becomes intermittent, there is no other option left to the consumers except for depending on private water suppliers.

The survey result further clearly reveals that though all categories of consumers (household, commercial, institutional) depends on private vendors to meet the demand of water, the dependency of commercial consumers turn out to be much higher as compared to other consumers. It has been clearly indicated that 100 percent of the commercial consumers surveyed responded their dependency on private vendors for the supply of water apart from Municipal water supply.

Tenzing Sherpa who runs hotel in Darjeeling mentioned...

“...The economy of Darjeeling is mostly dependent on tourism. As Darjeeling is known to be one of the famous tourist destination large number of tourist visits this place especially during October- December and March- May. Thus the demand of water increases with the influx of tourists and the hotel face herculean task just to provide water to the tourists. Hence, we are compelled to buy water from the vendor as municipal water is unpredictable and insufficient. During tourist season we buy 2 to 3 tanker of water every day that charges Rs.1400 per tanker (6500 liters). Shortage of water has affected the tourism industry in Darjeeling”.

There are, however, different types of private water vendors in Darjeeling. They include:

Hand Carts Vendors: They are generally small scale water sellers. They walk the distance and deliver water to the people's home and sell water on small quantity. These types of vendors are usually single men or women who collect water from the perennial and non perennial springs located within the town. Female vendors sell water in jerry can lifting by head load and the quantity of jerry can ranges from fifteen to twenty liters. They usually carry one or two jerry cans in a single trip. The price of water varies depending upon the distance travelled ranging from Rs 15 to Rs 20 per jerry can. On the other hand the male vendor's uses hand carts for the supply of water. Each cart holds 16 to 18 buckets at a time each with the quantity of fifteen liters. The price of water varies depending upon the distance usually it is Rs 100 per cart. It is a heavy and physically demanding activity.

Box 1: Handcart Vendor in Darjeeling

Sombadhur Thami, 35 years old has been residing in Darjeeling since 1996. He was born and brought up in a small village from Dolakha District of Nepal. He works as a water vendor in Darjeeling and has been engaged in this profession since last ten years. He collects water from the springs located within the town (mostly from the spring at “Dali”) and also buys water from the water tanker retailer and sells it in a hand cart. He collects water free of cost from the springs but, pays Rs 50 for 16 buckets (15 liters each), when he buys water from the retailer. He sells them at Rs.100 sometimes charges are raised depending upon the distance and mode of supply. The buckets in all carries 240 liters of water but more than ten liters of water are wasted during the delivery period. According to him the price of the water per cart has been raised from Rs 70 to Rs 100 since last two years.

He mainly supplies water to the households and small scale hotels. He earns maximum of Rs.500 to 600 in a day by selling water. He mentioned during dry period the demand for the water will be high and becomes very difficult to cater the demand of people as most of the spring gets dried off during dry season .During dry season we are not allowed to collect water from the springs managed by the Samaj during the day time, due to this we work whole night to collect water. On the other hand we are not allowed to run the carts on the highway during day time because the cart creates traffic jam. Hence, we deliver water till 7.30 in the morning and from 5.30 in the evening. In a day we can sell maximum four to five trips of water, as the cart becomes heavy and difficult to push.

Water Tanker Trucks Vendors: These are other category of private vendors operating in Darjeeling. These vendors sell water in large quantity as compared to handcarts vendors. They collect water from the rivers and streams from the outskirts of Darjeeling. Water tanker business has become lucrative. As a result many people in Darjeeling are seen converting their trucks to do water business. Today there are about 120 trucks that rounds selling water in the town. During the dry season a fleet of these trucks loads three to four trips of water in a day with the capacity of 5500 to 6500 liters of water in each trip. During the rest of the years 60 to 70 trucks ply every day.

Box2: Water Tanker Trucks Vendor in Darjeeling

Pasang Sherpa, 31 years old sells water in a tanker in Darjeeling. He is the resident of Bijanbari and has migrated to Darjeeling in search of better job. Today he sells water with his private truck. He has been engaged in this profession since last eleven years. According to him water business has now highly increased in Darjeeling. Poor and less educated unemployed youth mainly opt for water selling business in Darjeeling as this has become one of the easy methods of earning.

He collects water from Bijanbari forest which is about 15 km away from the main town. He mainly sells water to the hotels in the town. He has a permanent demand of water from five hotels where water is to be supplied daily. "During the dry season and peak tourist season the demand for water will be high so, sometimes I have to work whole night to collect and deliver the water" mentions Mr. Sherpa. Water is sold at the rate of Rs 1500 for full

Private Springs: These are the third category of vendors available in Darjeeling. They are mainly direct vendors who sell water to the consumers through pipe supply service from the spring's source located at their private area. Darjeeling being a hilly region and due to its steep slope ground water gushes out from the joints and fractured area or through the weak surface points in the form of portable source of water. Darjeeling has many such area where water is available that has spurt out from joints and fractures. People in Darjeeling usually sell water from such source that has thrived in their private area. Supply from these is done directly with the help of pipe system. Selling of water from these is one of the easiest and profitable means of earning to the people of Darjeeling.

Box 3: Private Spring Vendor in Darjeeling

Sarmila Lama Resident of Merry Villa ward number 11 sells water from the portable source available in her private land. She has been engaged in this work since last thirty two years (since 1982). This has added a source of income to her family. In the recent date water is supplied to 16 households from her source, through direct pipe system. Water is supplied to each household on an hour basis, where each house hold gets water every day for two hours. She has divided the time of supply in two shifts to avoid the conflict between the consumers, where 8 households gets water during morning shift and remaining 8 households water is supplied during the evening shift for two hours. However, during the dry period water is supplied on an alternate day to every household as the volume of water decreases. The consumers pay her on a monthly basis at the rate of Rs 500 /month.

The source being located on her private land, it is properly managed and maintained by her. A storage tank has been constructed where water is carefully stored and no amount of water is wasted. Deforestation is strictly prohibited around the source.

4.4. Community Based Organizations

Over the time Darjeeling has developed a unique community based organizations locally called as *Gaon Samaj*. It is a self organized grass root level social institution. In Darjeeling there are around 130 different Community based organizations (Joshi et al., 2011). These *Samaj* are located within the boundaries of municipal wards and they provide additional civic services, in the cases where the municipality are less active. They are basically self funding organizations. People collect small amount of money in term of fees and in turn they get assistance and support for social issues.

One of the most important and positive task or service provided by the Samaj in the town is the management and conservation of spring located with the municipal town which

Plate 7: Different Categories of Private Water Vendors in Darjeeling

Hand Cart Vendors



Private Springs Vendors



Water Tanker Trucks Vendors



Photo: Suvechha Ghatani, December 2014

are mainly not maintained and managed by the municipality. Out of the total 130 *Gaon Samaj* in Darjeeling only 32 of it possesses and manages the perennial spring.

Each of these *Samaj* takes the responsibility of management of springs located within their ward. Thus none of these *Samaj* takes care of more than one spring. As the official (municipal) water supply is unpredictable and insufficient people located within the periphery of the town depends on these spring water. In regard to the management of springs various conservation measures have been adopted by the *Samaj* like construction of storage tanks, organizing afforestation program in every six month in the spring site, pollution around the spring site area are strictly prohibited, no human activities are allowed within the spring site. Water are openly available to all the consumers within the wards and also to the consumers from other wards during the non lean period but certain rules and regulations are imposed during the dry season by the community members when the volume of water decreases drastically. Rules like i) people from outside the wards are not allowed to collect water from the spring, ii) washing clothes and bathing are strictly prohibited in the spring during the dry season, iii) certain timing and quantity is fixed for the collection of water iv) distribution of water is done through jerry can queue. These rules and regulations are being implemented so that every member in the community gets equal share of water even during the time to scarcity. Apart from these *Samaj*, religious organizations like *Sai Samity*, *Church community* also play an active role in cleanness, management and maintenance of these springs.

4.5. Analysis of Water Consumers

After the analysis of water service provision in Darjeeling, following section presents an analysis of various aspects of water consumers in the study area. The study was conducted in respect of three different types of consumers namely domestic, commercial and institutional consumers in order to have an idea about water availability situation from the different perspectives.

4.5.1. Profile of the Sampled Consumers

Out of the total 75 households that have been selected for the survey, 60 percent of the respondents were male and 40 percent were female respondents. An average

household size of the sample households was 4.32 with an average size ranging from 4 to 5 persons per household. The sex ratio of the sampled household resembled 794 female per thousand male.

The data with reference to their level of educational depicted that the majority of populations were well educated in Darjeeling. 43 percent has graduate degree, 31.3 percent had education till higher secondary level, 15 percent had secondary level of education, 4.3 percent had primary level of education and 5.3 percent had education above graduate level. The data reflects that the majority of population in Darjeeling has education at least till graduate level.

The sampled households had different occupations. These include government services, private jobs, businesses and others (retired persons). Analysis of the sample household showed that 42 percent were government employees, businessmen constitute 27.7 percent, 23.2 percent were private job holders and 7 percent constituted the retired persons.

Regarding the income of the sample household, the data revealed an average household income amounted to 16,800 per month, ranging from 8,000 to 50,000. Out of the total sample household 33.3 percent had income below the average while 56 percent of the household had income above the average. However the remaining 10.6 percent of the respondents were not willing to reveal their income. Half of the household had two income earners whereas more than one third had only one earner.

Out of total 15 commercial consumers that were selected for the survey, all the respondents were hotel owners. Seven of the respondents belonged to high income hotels whereas eight of the respondents belonged to the middle class (income) hotels. Further, out of five institutional consumers that were selected for the sample, three were educational institutions (schools) and two were government offices.

4.5.2. Average Use of Water per day

The given table shows an average use of water per day at domestic, commercial and institutional level. The study reveals that an average consumption rate of water for household is 404 liters/day, while average consumption rate of water per head is found to

be 93.7 liters/day. Thus it is obvious from the table that the per capita water consumption in the study area is found to be much lower than as recommended by the bureau of Indian Standard ISI 177-1993 which is 135 lpcd. On the other hand the commercial sector on an average consumes 1320 liters of water per day and that of institutional consumers 740 liters of water per day respectively. Thus, the findings on average use of water reveals that the quantity of water available to these consumers has been much low.

Table 16: Average Use of Water Per day

Consumers	Average use of water (liters/day)	Per capita water consumption (liters/day)
Domestic	404.0	93.7
Commercial	1320 .0	-
Institutional	740	-

Source: Primary Survey, December 2014

4.5.3. Major Sources of Water

The study revealed that the need of water in the study area is fulfilled by different sources depending upon the convenience and the affordability of the users. People were depended either on natural springs or municipality or private vendors. Table 17 resembles the major sources of water in the study area and it reflects that municipality water supply is the primary source of water to the majority of people living in Darjeeling town. Out of the total sample size taken for the domestic consumers, 81 percent of them depended on municipal water supply. However 19 percent of people rely on the natural spring for the supply. On the other hand 60 percent of commercial consumers depended on municipal water supply and 40 percent of them were dependent on private vendor. Almost all the institutions surveyed were dependent on municipal water for their water requirements. From the given table it can be analyzed that large proportions of population in the study area are has Municipal water supply as their major source of water. Dependence of people on the municipal water is high mainly in the core town area and as one move towards the intermediate zone of the town dependency on Municipal water supply decreases gradually.

Table 17: Major Sources of Water

	Sources		
Consumers	Municipality (% of respondents)	Private Vendor (% of respondents)	Natural Springs (% of respondents)
Domestic	81.0	-	19.0
Commercial	60.0	40.0	-
Institutions	100.0	-	-

Source: Primary Survey, December 2014

4.5.4. Sufficiency with the Available Source

Table 18 shows the level of sufficiency of water from the available source. Out of total respondent dependent on natural springs 37.5 percent of domestic consumers gave the negative response while 64.2 percent gave the positive response. According to the respondents the availability of water from the spring becomes insufficient mainly during the dry seasons when the volume of springs decreases to about 50 percent.

On the other hand when inquired about the sufficiency of municipal water supply almost all sectors of consumers gave negative response resembling that the municipal water supply was not sufficient for the consumers. 91.8 percent of the domestic consumer reported the negative response, almost all the commercial consumers responded with the negative response and 80 percent of the institutional consumers responded with the negative response on sufficiency with municipal water supply.

In response to the question about the sufficiency of municipal water supply Avinash Tamang resident of ward number 1 responded:

“...Municipality water supply is not sufficient, it is highly irregular and that too comes for a short of time period .In our ward municipality water opens once in four days, due to slow pressure on the water hardly we get 200 liters of water. So, we have to rely on private water supply as well apart from municipality water supply”.

The other responded Sujata Yalmo who runs a restaurant in ward number 2 says:

“.... I don’t have domestic water connection; I depend on public hydrant for municipal water supply when the municipal water opens once in 7days during dry period I can hardly get 80 liters of water at a time. The pressure on the water is very low and the queue to fetch water is long. So, apart from municipal water we have to depend on private water vendors who sell water at much higher price”.

Similarly Tashi Pencho who owns hotel in ward number 15 noted:

“.....We get water once in three /four days even in the rainy season and that too for the limited period of time. During dry period water is supplied at an interval of ten to fifteen days by the municipality which is not sufficient as a result of this we are compelled to buy water from the private vendors. Darjeeling the “queen of hills” being one of the famous tourist destinations in India large number of tourist visits this place but shortage of water has seriously affected the thriving business and the tourism sector in the long run”.

Table 18: Level of sufficiency of consumers

Consumers	Municipality (% of respondent)		Natural Springs (% of respondent)		Private Vendor (% of respondent)	
	Sufficient	Insufficient	Sufficient	Insufficient	Sufficient	Insufficient
Domestic	8.2	91.8	64.2.0	37.5	-	-
Commercial	-	100.0	-	-	85	15
Institutional	20.0	80.0	-	-	-	-

Source: Primary Survey, December 2014

4.5.5. Additional requirement of water

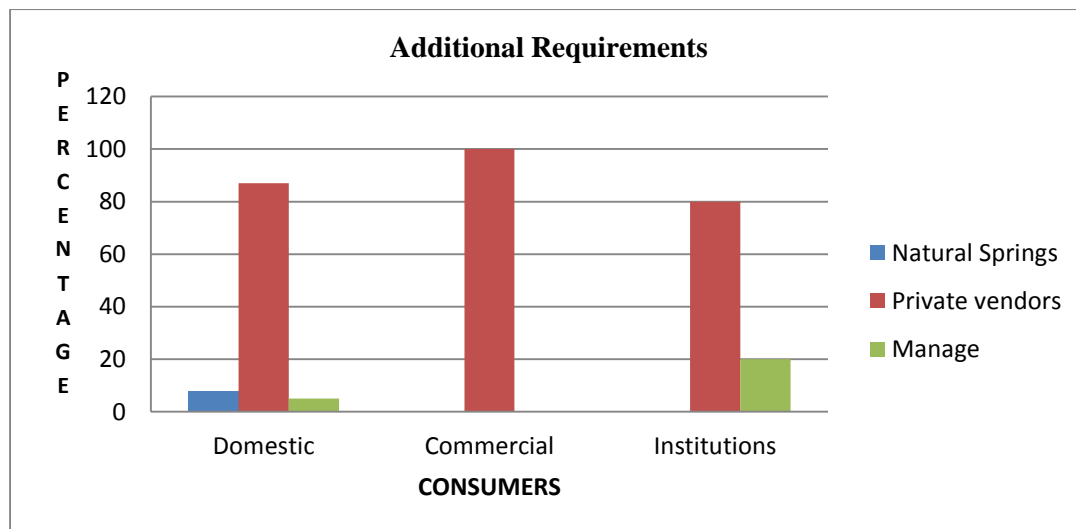
Table 19 shows the source for the additional requirements in case of insufficiency of water. The study revealed, apart from municipal water supply consumers were dependent on the other alternative sources as well to meet the adequate requirements. Majority of consumers were dependent on private vendors for the additional requirements, few number of domestic consumers dependent on natural springs and some of the consumers responded that they manage with the available water whereas. Mainly consumers with small family size responded that they manage with the available source. However, the study depicts private players have played a very important role in meeting the additional requirements of the consumers.

Table 19: Additional Requirements

Consumers	Natural Springs (% of respondents)	Private Vendor (% of respondents)	Manage with the available water (% of respondents)
Domestic	8.0	87.0	5.0
Commercial	-	100.0	-
Institutional	-	80.0	20.0

Source: Primary Survey, December 2014

Figure 8: Additional Requirements of Water



4.5.6. Satisfaction with the Municipal Water Supply

Table 20 shows the level of satisfaction of consumers of different sectors with the municipal water supply. Thus the study reveals that majority of respondents (consumers) are not at all satisfied with the level of water supplied by the municipality. 72 percent of domestic consumers, 86 percent of commercial consumers and 80 percent of the institutional consumers responded the water supplied by the municipality to be unsatisfactory to the consumers. They mentioned apart from paying the service tax on a regular basis they are not getting the satisfied amount of water. The available water are insufficient and at the same time they are highly irregular. The frequency of water supply is very intermittent mainly during the dry seasons. Water is supplied once in 15 days during the dry periods and once in four to five days during the non dry periods. Such a situation has led to high level of dissatisfaction among the consumers from the Municipal Water Supply.

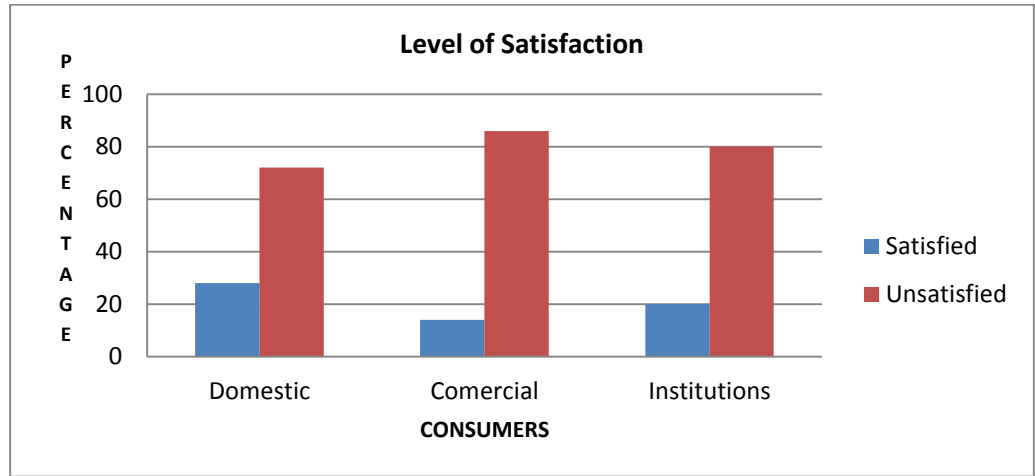
In response to the question about the level of satisfaction with the municipal water supply one of the respondent Mr. Subodh Pakhring resident of ward number four says “...Municipal water supply service is worse in case of Darjeeling, and it is primarily due to total executive, administrative, legislative and political system failure and negligence.

Table 20: Satisfaction with Municipal Water Supply

Consumers	Level of Satisfaction	
	Satisfied (%)	Unsatisfied (%)
Domestic	28.0	72.0
Commercial	14.0	86.0
Institutions	20.0	80.0

Source: Primary Survey, December 2014

Figure 9: Level of Satisfaction with Municipal Water Supply



4.5.7. Public Participation

Public participation in decision making is an important component for equality and fairness in the process and also strengthening of civil society. The respondents when asked whether they were aware if Municipality or PHED have ever involved the public, in discussing about the water supply and management problems in Darjeeling. Majority of respondents indicated about not having any knowledge about such meetings. When asked if they were ever invited by the municipality or PHED to share their ideas or views relating to water management and supply, they responded that they were never involved or asked for the opinion on any matter of water management system. According to the respondents the public participants is restricted till election of the ward councilors and the role of common people in any kind of decision making is almost absent or non-existent.

On the other hand, when inquired with the authorities, they however, feel that the process is democratic, the decision is made by the Municipal Board and they are all representatives of the people so, in a way the people are making the decisions.

4.5.8. Willingness to pay more for improved water supply

Table 21 shows willingness of the consumers to pay more for the improved water supply service. Analysis on people’s willingness to pay more for improved water supply

service shows that majority of consumers were willing to pay more for the improved water supply service. 77 percent of the domestic consumers, 86.6 percent of the commercial consumers and 80 percent of the institutional consumers were willing to pay more for the improved supply. Thus this indicates that majority of people have further demand for the better service than the existing service.

Pramila Rumba resident of ward number 24 says:

“... We are ready to increase our tax rate but the water supply service should be managed properly by the municipality. Water should be provided to the consumer on a daily basis or in an alternate day at least for an hour.

Another respondent Lakpa Yalmo resident from ward number 31 who is not willing to pay says

“... Waterworks department should rise up and be efficient if they can collect the tax than they can repair all the broken pipes and extend their maintenance work.

Another respondent Sharmila Subba resident of ward number 31 says:

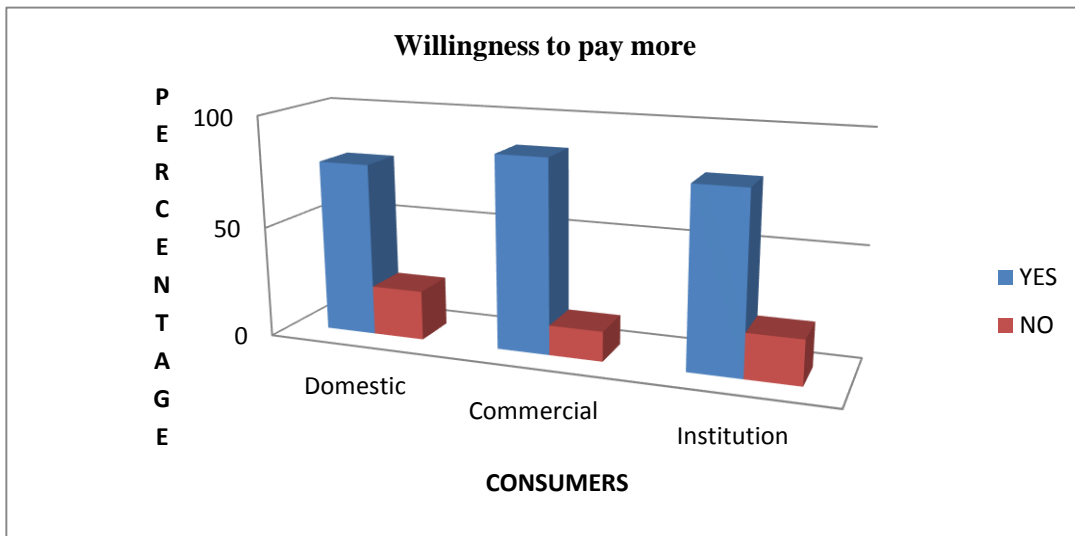
“...Willingness to pay more depends on the situation let the improvement work begin and then we will take the decision. Sufficient amount of fund is generated through tax and funds from the government. Water works should have effective monitoring team to minimize the illegal tapping and waste through leakages.

Table 21: Willingness to Pay More

Consumers	Willingness to pay more	
	Yes (% of respondent)	No (% of respondent)
Domestic	77.8	22.2
Commercial	86.6	13.4
Institution	80	20

Source: Primary Survey, December 2014

Figure 10: Willingness to pay more for Improved Water Supply



4.6. Factors of Water Scarcity in Darjeeling Municipal Area

It is also important to comprehend the problems and issues relating to water scarcity other than understanding the management system. The factors primarily responsible for shortage or scarcity of water in the study area are discussed below:

4.6.1. Rapid Growth of Population

Darjeeling municipality currently has the population of 1, 20,414 and this does not include the floating population like students, tourists, migrant workers etc. Apart from the residential population Darjeeling also receives the huge number of tourist population during the peak tourist season every year due to which 25000 to 35000 of population is added to the town during the peak tourist season. Taking all this, on an average population of the town will reach to about more than two lakh. Such an increase in the population has imposed high burden upon the municipal water supply system and has becomes difficult to accommodate the ever growing population with proper water service. Thus, high surge in population with inefficient water management has led to water scarcity in Darjeeling.

4.6.2. Old Distribution System

About 95 percent of the distribution system like pipelines and valves were laid in 1910-15, i.e. at the time of introducing water supply through pipeline in Darjeeling town. As a result of this the system also leaks through bad connection and abandoned pipe loops. Not a single work was done in to replace the old pipelines and leaking valves. Some of the pipes are broken down due to cold weather condition. Very little maintenance works were taken up, since most of the repair/ restoration works were done up on ad-hoc basis only. The networks have not been maintained properly from the time it was installed excluding some patchwork projects 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. The water loss in piping is officially estimated as 25 percent; however, this seems to be an underestimation figure. In some places the cases are seen where the broken pipes gets mixed with the damaged sewerage lines running through the town with several leakages, however this leads to severe contamination of water.

4.6.3. Increase in Demand

Rapid growth of population, extensive urbanization and rise in the standard of living has imposed high increase in the demand of water in Darjeeling. Apart from the natural increase in population, rural to urban migration has led to increase in population ultimately leading to increase in the demand of water. With the increase in urbanization

and being a famous tourist destination, large numbers of hotels, restaurants and other commercial centers etc have come up haphazardly leading to increase in the demand of water.

4.6.4. Illegal Tapping of Water

In addition to old distribution system, which lowers the actual production of water supply, illegal tapping of water has further reduced the amount of water supply that can reach the customer. Such a situation has added further problem to the shortage and scarcity of water supply in the study area. It is one of the sad truth of Darjeeling that most of the connecting pipelines are seen to be convincingly vandalized at various places from where people illegally tap the water. Valves are often seen to be broken due to tapping of water during the night time. Further, in most of the cases pipe fitters are too cheating the system by taking bribes for an illegal connection.

4.6.5. Absence of Metering System

The water usage metering system is absent in the study area till date. Therefore the actual water consumption or per capita municipal water consumption is not known or there is no reliable estimate on it. There are flat rates for water tax. This has led to the major obstruction on the way of any future planning. There is no real metering system of water usage at any point of the network (supply and distribution system), hence the estimates on water usages at municipal level are done by measuring the water level in the reservoir and the subsidiary tanks. Water is not evenly distributed across the town as a result of which some ward have considerably more limited water supply than the other wards. The distribution system is mainly confined to the central part of the town and at the government buildings and residential areas. Most parts of the peripheral areas of the towns are far from the reach of the municipal pipelines. Absence of metering system has led to unequal distribution of water within the municipal area.

4.6.6. Pollution

Increasing pollution is the other major problem in Darjeeling adding to water scarcity. The traditional "Roll down the hill" waste management system of Darjeeling as they have been doing all these years as it is contaminating the landscape and the available water resource. Darjeeling produces 30 metric tonnes of waste per day which increases to

45 metric tonnes during the peak tourist season. One truck carries two to two and half metric tonnes of waste, every month five hundred trucks of waste are dumped into waterways, *jhoras* without any segregation (ATREE, 2010). Toxic chemicals are being released into the atmosphere through burning and leached into the soil and waterways through dumping. Runoff from open dump sites containing chemicals leads to contamination of water resources. There has been a build-up of non-degradable waste due to dumping on the land, soil and waterways and this ultimately leading to threat of landslides during monsoon season. Lack of proper waste management system is leading to contamination of the precious water resource at large scale in Darjeeling.

4.6.7. Absence of Waste Water Treatment Plant

Absence of waste water treatment plants in the study area till date is the other important factor contributing to shortage and scarcity of water .There is no provision for recycling and reuse of waste water. Large volume of waste water runs through sewerage pipes, *jhoras*, roadside drains every day, recycle and reuse of such water would have been helpful in reducing the scarcity of water , but absence of treatment facility has led to wastage of water ultimately resulting to contamination of water and hence inviting various illness in the town.

4.6.8. Shortage of Storage tanks and Reservoirs

Apart from the absence of waste water treatment plant insufficient number of storage tanks and reservoirs is the other major problem for the shortage of water in Darjeeling. Darjeeling has umpteen number of water resources in the form of springs and streams, large amount of water are wasted due to insufficient number of storage system. Sinchel catchment area has 26 numbers of springs, during rainy season the collection of water from the eight springs becomes sufficient to fill up the existing reservoir; rest of the water has to be siphon invariably into the *jhoras* due to limited capacity of reservoirs at Sinchel catchment area. Similarly, there are large numbers of springs located within the town area, absence of storage tanks leads to heavy loss of water especially during the monsoon season and during the night hours.

4.6.9. Lack of Public Awareness

Lack of public awareness is the other crucial reason leading to water scarcity in Darjeeling. For example, most of the connecting pipes along the roads are sometimes convincingly vandalized, from where people illegally appropriate water, not realizing that this will ultimately led to more water scarcity. The pipes are sometimes left cut or broken for a long time without anyone caring to join them again, due to which large gallons of water gets wasted, causing further shortage in the long run. Moreover we can also see water overflowing from the water tanks of the houses. The owners of the houses do not conserve water which flow away in waste.

4.7. Factors Affecting Municipal Water Management System

4.7.1. Limited Institutional Capacity

Shortage of skilled manpower is one of the critical issues faced by Municipality. This constraint is one of the major limiting factors in the fulfillment of desired service provision in the region. In addition to this inadequate equipment facilities and other material required have further made the nature of problem worse. Municipality also suffers from lack of long term vision; strategy and proper action plan to facilitate the efficient supply and management system. This has been mainly caused due to lack cooperation with the state authorities. Further, several other problems caused by inefficient organizational arrangement, inadequate number of staffs, inability of Municipality to keep or recruit trained and experienced staffs are the other major constraints for rendering proper management and service delivery at municipal level.

4.7.2. Inadequate Budget

Delivery of urban water supply requires a high level of investment. Lack of sufficient funding has limited the quantity and quality of water supply service at the municipal level in Darjeeling. The large existing waterworks in Darjeeling requires a maintenance grant of Rs 4 lakh per year according to PHE norms but the Municipality can hardly afford Rs 40- 50 thousand per year and that too occasionally when the scarcity of water is acute. Thus lack of effective funds has seriously hampered the management system. Due to shortage of sufficient funds various problems have been encountered, one

of such is the stoppage of chlorination of drinking water at Filter house. Chlorination of water in the recent date is done by bleaching powder which is not adequate for proper filtration of water. Moreover, lack of efficient cost recovery mechanism has often inhabited Municipality from sustaining even the existing service.

4.7.3. No Community Participation in Decision Making

The participation of local communities and people on decision making process relating to water management at municipal level is almost absent or nonexistent in case of Darjeeling. The decision making process are typically centralized and bureaucratic in nature in Darjeeling. Decisions are mainly made by the people who own the majority in election. Public opinion and suggestions are not entertained. This is the other major factor affecting proper management of water resource. Involving the community during planning, implementation and operation period of the scheme and executing the given suggestion will helps to create sense of ownership to the people and further will help to ensure sustainability on the water supply scheme.

4.8. Conclusion

Good governance on water resource is necessary for it allows for enhanced sustainable use of water and also leads to ecosystem integrity. In case of water sector, governance is a broad term that includes institutions, organizations, policies and practices that helps to manage and shape the water resources including the delivery of water services for large populations. Governance is one of the important indicators for sustainable management of water. Hence, in case of Darjeeling the management system of water resource is primitive and rudimentary. Lack of educate funding and improper governance system has hampered the infrastructural development. Further, rapid growth of population in Darjeeling has adversely misguided the nature of demand and supply of water and has led to increase in the intensity of shortage of water. Lack of effective co-ordination between the pubic and decision makers has also affected efficient management scenario of water resource in Darjeeling. Absence of public participation in the decision making process has hindered the active participation of public in sustainable management

of water resources. Further, there has emerged a kind of feeling that municipality is not an integral part of the community but is like an artificial creation on the other side.

Private players have led to an important contributions in the catering the need of people. Large number of population depends on private water suppliers for the additional requirement of water. They serve about half of the populations in the town to meet the need of water required. On the other hand various factors like inappropriate institutional management, lack of awareness among the public, insufficient number of reservoirs, illegal tapping, leakages in pipelines etc. are the other important factor that have seriously affected water management system in Darjeeling ultimately leaving area with acute water scarcity.

Plate 8: Leakage of Distribution Lines and Illegal Tapping of Water



Source: Municipality Report, 2010

Plate 9: People Collecting Water from Leakage Valves



Photo: Suvechha Ghatani, December 2014

CHAPTER 5

CONCLUSION

The growth and development of Darjeeling in various forms started with the advent of Britishers in Darjeeling. British mainly developed Darjeeling for catering their own needs of comfort and control for which they turned the region into hill a resort. The region was also developed as a centre for the missionary activities, educational institutions and trade centers. In this way, the region attracted migrants from others regions and developed it into an extensive urban centre. Thus, the exquisite scenic grandeur and invigorating climate of Darjeeling earned the title of “queen of hills”.

Darjeeling Municipality established on 1st July 1850 is one of the oldest cities administrative bodies of India; it is also primarily responsible for the civic administration of the town of Darjeeling. Besides the various services provided by the municipality, one of the basic service provided is the supply of drinking water. It the major source of water supply for the people in the town. The whole distribution system of water in Darjeeling is primarily made under the jurisdiction of Darjeeling Municipality and water is supplied through piped system.

However, rapid increase in population, extensive urbanization, economic development and climate change have seriously affected the pattern of water demand and supply in the recent time leading an area to acute water scarcity. Further lack of proper management system in the study area has affected the sustainable use of water.

Groundwater (springs) are the major sources of water in Darjeeling. Due to steeper gradient and higher relief of the area water comes out as seepages or springs whenever the land surface intersects the local ground water table. Although, the supply of water with adequate quantity and acceptable quality is one of the basic needs of human being, the scarcity of water has always created a cause of worry for the people living in Darjeeling. Though, Darjeeling has sufficient number of water resource available in the

form of springs, streams, *jhoras*, lack of efficient planning for the proper management of available water resource has resulted in the shortage of water and ultimately leading to scarcity of water to meet the demand of people in the town.

Apart from municipal water supply, private vendors, springs located within the municipal area that are managed or maintained by the *Gown Samaj* are also found to be the other convenient source of water for the city dwellers. From the survey of the area, the fact that came into light is that the municipal supply of water is highly irregular, unpredictable and inadequate to satisfy the need of the people. The supply becomes much more sporadic especially during the dry seasons when the water is supplied only once in a week and that too with very low pressure. Due to this very little amount of water can be consumed at given time. The condition seems to be worse mainly in the peripheral areas of the town where the people receives water only twice in a month during the dry season.

The insufficiency and irregularity of public water supply has affected on an average 83.3 percent of consumers in the area. Such a chaotic situation had left with no other option than depending upon the private water suppliers to meet the required needs. Private vendors support around half of the users in the area. Further, people living in the periphery of the town also depend on the springs available within the area. From the result of survey analysis, the average per capita water consumption per household in the study area was found to be 93.7 lpcd against the Indian urban standard of 135 lpcd. Briefly it can be stated that the status of water available to the people in the study area (Darjeeling Town) is below the average standard that has been set for the Indian Urban Standard and this requires an immediate attention.

Due to the poor functioning of the existing water supply scenario most of the consumers are willing to pay higher price for the improved water supply service. Thus, this prevalence of willingness to pay for the improved supply implies that there is further demand for the existing water supply system in the town. Since, the existing water supply is not convenient for the consumers they are in need of better service through high price.

The existing water supply system was installed during the colonial period with the target of about 10,000 populations. The town still depends on the same system when the

population has increased to 1, 20,414 and on an average population increases to about two lakh during the tourist season. The official supply of water covers only 51 percent (half) of the total holdings as a result of this huge gap between the demand and supply of water has been observed in the area. Further due to old supply system most of the pipelines are seen to be leaking and broken due to which large volume of water is wasted.

Darjeeling receives 309.2 cm of rainfall, large amount of water runs waste through drains and *jhoras* due to absence of proper harvesting system. On the other hand the study revealed, out of total 26 numbers of springs that feed Sinchel Lakes, during the rainy season water from the 8 springs will be sufficient to fill up the lakes. Rest of the water has to be diverted to the *jhoras* and streams due to insufficient reservoir. Similarly, million gallons of water are being wasted from the springs located with the town especially during the night time due to lack of storage facility. In this way million gallons of water are wasted in Darjeeling.

Among the various factors influencing sustainable management of water resource in Darjeeling, decision making, lack of funds, lack of transparency and information sharing, relationship between political stability and governance, and self-organized grass roots level organizations have been recognized as the key factors. The decision making process in terms of water resource management in Darjeeling at the municipal level are typically centralizes and bureaucratic in nature. There is usually a gap between decision makers and the public in terms of information taken by the authorities, they usually does not involve public for discussion and consultation as a result of this majority of plans fails due to lack of public support and participation. From the respondents information it was observed that the public participation in decision making was restricted till electing the representatives of ward councilors, further the role of common people in decision making is almost absent or nonexistent. In addition, the changing political scenario in Darjeeling has also seriously affected the management system. The decisions are usually made by those who own the power and the plans and processes initiated by the previous people in power are often abandoned or cancelled mid-way if a new set of people come in power. Hence, many projects has been left incomplete or are neglected. Insufficiency of funds collected has also influenced in the proper management system.

Delivery of urban water supply requires a high level of investment but the amount generated today by the Municipality are not sufficient to meet the required demand. It was further observed that the community based organizations or *Samaj* and religious organizations etc. have the potential to influence the water resource management in a positive manner by involving and ensuring public participation in water resource management system and the decision making process.

Though the access to clean and protected drinking water has been treated a fundamental right for the people in India, but the provision of portable water to the people of Darjeeling has always been insufficient and shortage of water has always been a cause of worry for the people living in Darjeeling.

Having looked into the current issues and scenario of water management system in Darjeeling it can be clearly stated that the need for development of comprehensive and sustainable water resource management plan is of paramount importance in Darjeeling. According to the analysis based on the key factors like nature and pattern of demand and supply, satisfaction of consumers, consumption of water, availability etc. shows that the current management system of water resource is unsustainable in the long run. Although the city is growing very rapidly in many aspects, in its external face and modernization of infrastructure but, it can be said that in terms of growth of necessity the situation is different. The very basic necessity of life are deteriorating with the passage of year in terms of both quality and quantity and people are compelled to compromise with the basic need of their existence.

Thus sustainable management of water is possible only if there will be proper coordination and joined up thinking among the different stakeholders such as public and private sectors, local communities for the management so that the laws, plans, policies and actions are not contradictory. Apart from the importance of proper planning there is also need for the conservation of available water resource, prevent degradation so as to attain sustainability.

Though, Darjeeling experiences natural pressure of limited water sources that can be experienced exceptionally during the dry season. However, in general the availability

of water resources are large and with the better designed infrastructure and proper planning it can be made available for all people. In general it can be concluded that until and unless all the public are aware and involved in the management process of water resource a durable and sustainable management of water resource is not possible.

5.1 Policy Recommendations

The sustainability of water resource management though depends on numerous factors, however the most important factor is the will of the people to make appropriate change to improve the existing management system and develop something better. It is thus important to understand that water management and its conservation plays a vital role in enabling sustainable urban environment.

From the study it can be clearly understood that the people in Darjeeling municipal area in general are willing to contribute positively and participate in water resource management system and Darjeeling Municipality also seems open to ideas and opinions for the betterment of water resource of the town. Based on the given background following recommendations can be made for sustainable management of water-

Community Consultation and Involvement in Decision Making

In case of Darjeeling, development of plans and policies has always been in the favor of those, who owns the power. In such case it is apparent that the management strategy implemented for water resource management will not be sustainable, because sustainable management of water resource depends on the interest and participation of citizens in the system. Hence, involvement of community, CBO (community based organizations) in decision making process will ensure sustainability in water resource management. This may in turn help Darjeeling Municipality to bring the issues at the hand of people and make them aware of the existing problems. Through this process people will be able to share their idea, thoughts and concerns regarding various aspects of management in water resource in Darjeeling. This may also help to make the system transparent and efficient, as decisions once taken with general consent will be easier to

execute. People will be hopefully more willing to help to execute the plan by conserving the water resource and adopting optimal utilization.

Ensuring the Principal of Optimal Use of Water

The available water should be equitably distributed to the community as this will ensure impartiality on tax paid. If equitable distribution of water to the community will be put into action, this will not only ensure efficient and optimal use of water resource but also leads to consumption of water from similar other sources for additional requirement. Thus, this will help to maintain sustainability of the source by limiting its depletion.

Provision of Water Harvesting and Waste Water Treatment Plan

Large volume of water is wasted through drains, *jhoras* and springs especially during the rainy season due to lack of proper harvesting system. Similarly, the water running through the sewerage lines, *jhoras* etc. are wasted due to lack of proper treatment plant. In this way millions of water are being wasted in Darjeeling. Encouragement of proper rain water harvesting system and waste water treatment plant would led to conservation of water that would support the town in providing sufficient amount of water.

Strengthen Institutional Management System

Water management can be rational if only the institutions responsible for such management are efficient. Development of long term proper plan keeping in view the rational utilization, protection, conservation and management of water resource based on community need will help to ensure sustainability of water. Further water resource planning should also be linked with the socio- economic planning. Further strict enforcement of laws against water misuse and enforcement of rules and regulations on illegal connection and misuse of water. Optimization of the budget on public utility services will help to maintain its service levels. The existing unsatisfying tax collection on utility services by Darjeeling Municipality can be improved by imposing strict fine for late payments and offering convenient payment.

Responsive Bureaucracy

Bureaucracy is the back bone to any civil organization. There is very important linkage between the political setup and water resource management in case of Darjeeling. The

decision on the plans and policies are usually changed with the changing political situation. However the decisions made by the previous board are often not followed or are completely quashed. In such continuously changing political situations, the bureaucrats ought to play an active role in ensuring that the projects and plans are not affected by the prevailing political situation. In the case of a change in government at provisions should be made that the previous plans and processes, started by the previous board must not be allowed to be abandoned mid way which results in loss of time and resource.

Introduction of long term Plan for the Town

Absence of Town Planning Department in Darjeeling till the recent time has led to unplanned development of town causing a range of problems. Absence of physical planning such as land use planning in the study area has thus inspired the unplanned growth of the town. This has further led to lack of scope for the lateral expansion of the town. Moreover, rapid growth of population and economic development in the recent decade has contributed in making Darjeeling an unpleasant town to live in. Rapid growth of population is forcing the current dumping ground to be surrounded by growing villages. Absence of town planning has welcomed the haphazard construction of buildings with no limitations in its heights. It is further characterized by illegal felling of trees, export of medicinal plants etc. Such a situation has been execrating continuous pressure on the natural resource and leading to unsustainable development of town. Darjeeling has lost its proud title “queen of hills” over the years. Therefore, implementation of proper plan for the town is of vital importance in Darjeeling in order to check the unsustainable development of town.

Raising Awareness Programs

Proper awareness will potentially offer more realistic vision for achieving sustainability. As Darwish and Al Najem, (2005) has mentioned an increase in environmental awareness and knowledge among the public in community should be considered as an mandatory action and one of the key step towards sustainability. It is essential to organize awareness program in each ward by the municipality and to educate the masses about the causes of degradation, depletion, pollution of water resource and resultant future threat along with the methods of preventing such catastrophe. It is also essential to inspire the society about

the importance of resources, its preservation, restoration and rational use and also offer better understanding about interaction and effect of natural resources on mankind. However, until and unless the people realize the impact of their selfish and careless act on the available water resource a possible dream of managing this crisis and attaining sustainability will be lost forever.

The recommendations have been made by understanding the strength, weakness and problems associated with the existing water management system in Darjeeling and on the basis of literature that has been reviewed, understanding the issues and problems and suggestions made by the respondents to enhance better management system for the available water resource.

The study primarily focused on the study of water resources available in Darjeeling and understanding its management system. Further studies can be attempted in order to understand the impact of water scarcity on the socio-economic conditions of urban poor in the area. It is clear from the study that private players have made significant contributions the need of water for the people in Darjeeling Municipal Town. A more detailed research can be undertaken to investigate if Public Private Partnership may help to solve the water shortage problem in Darjeeling.

Plate 10: People Trying to Collect Water from wherever it is Available



Photo: Suvechha Ghatani, December 2014

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APPENDIX 1

Principles of effective water governance

Open and Transparent: Water institutions should work in an open and transparent manner, using language understandable to the general public; water policy decisions should be transparent, particularly regarding financial transactions.

Inclusive and communicative: wide participation should be ensured throughout the water policy chain, from conception to implementation and evaluation; governance institutions must communicate among water stakeholders both horizontally at the same levels and vertically between levels.

Coherent and integrative: water policies and actions must be coherent, with political leadership and a strong responsibility taken by institutions at different levels; water institutions should consider all potential water users and sectors and their linkages with, and impacts on, the traditional water sector.

Equitable and ethical: equity between and among various water interest groups, stakeholders and consumers should be carefully monitored throughout the policy development and implementation process; penalties for corrupt behavior or sharp practices should be applied equitably – water governance must be strongly based on the ethical principles of the society in which it functions and on the rule of law.

Accountable: the rules of the game, as well as legislative roles and executive processes, must be clear; each water-related institution must explain and take responsibility for its actions; penalties for violating the rules and arbitration-enforcing mechanisms must exist to ensure that satisfactory solutions to water issues can be reached.

Efficient: concepts of political, social, and environmental efficiency related to water resources must be balanced against simple economic efficiency; governmental systems should not impede needed actions.

Responsive and sustainable: water demands, evaluation of future water impacts and past experiences should be the basis for water policy; policies should be implemented, and decisions made, at the most appropriate level; water policies should be incentive-based, to ensure clear social or economic gain if the policy is followed; long-term sustainability of water resources should be the guiding principle.

APPENDIX -II

Ward Wise Water Supply Deficiencies

Water Supply Deficiencies	Number of Wards
----------------------------------	------------------------

Insufficient length of pipe line	1,2,8,7,10,11,13,14,18,19,20
In some cases due to leakage drinking water gets Polluted	1,2,3,6,7,10,13,19
Municipality is the sole supplier of drinking water	Yes
Non availability of fresh water	All Wards
Non-existence of water supply as yet	8,11,20,19 (partly)
Poor condition of existing pipe line	All Wards
Inadequate number of house connection	1,2,3,6,7,10,13,19
Inadequate quantum of drinking water supply	1,8,13,14
No Pipeline	1,8,19,20
Insufficient Number of Stand Posts	1,2,3,7,10,11,13

Source: Municipality Report, 2010

APPENDIX III

HOUSEHOLD SCHEDULE

- **General Information**

a. Name of Respondent: _____

b. Religion: _____ c. Caste: _____ d. Ward No.: _____

e. Household Composition:

Sl. No	Relation	Age	Sex	Marital Status	Education	Nature of Employment	Monthly Income	Current Residence
--------	----------	-----	-----	----------------	-----------	----------------------	----------------	-------------------

1	Self							
2								
3								
4								
5								
6								
7								
8								

f. Whether APL/ BPL: _____

• **Water Related Information**

a. What is the major source of water for the household use?

i) Municipality ii) Natural Springs
 iii) Private Water Vendors iv) Other

b. How much water does your household utilize in a day for:

Drinking and Cooking	
Domestic Use	
Others	

c. Is the water sufficient for HH use? **YES/NO**

If **No** then how do you manage the additional requirement?

Natural Springs	
Buy from private vendors	
Manage with the available water	
Any Other (Please specify)	

- **Municipal Water Supply**

1. How much do you pay as Municipality water tax monthly/annual
2. What is the Frequency and Quantity of Municipal water supply?

Lean Period		Non Lean Period	
Frequency	Quantity	Frequency	Quantity
Once in a day		Once in a day	
Once in two days		Once in two days	
Once in three days		Once in three days	
Once in a week		Once in a week	

3. On the day of water supply for how many hours do you get water?

Less than 1 hour	1 to 2 hour	2 to 3 hours	3 to 4 hours	Above 4 hours

4. Is the frequency/quantity/time sufficient for your HH? **YES/ NO.**

If no, what are the suggested frequency/quantity/ time?

5. Are you satisfied with the existing municipal water supply system? **YES/ NO.**

If **No** then can you suggest some remedial measures to improve the water supply situation?

6. How do you rate the existing municipal water supply situation in your ward?

a. Bad

b. Satisfactory

c. Good

d. Excillent

7. If the Municipality improves its water supply service, would you be willing to pay more for water? **Yes/ No.** Explain.

8. What aspects of water service do you think needs improvement in future?

- i) Quality/quantity ii) Maintenance iii) Frequency
- iv) Service v) Pressure vi) Others

• **Private Water Supply**

1. Do you buy water from private vendors? **YES/ NO**

If **YES** specify the quantity per day

2. What is the rate per Tank/Jar/Bucket?

3. How do you rate the quality of privately purchased water?

Excellent	Good	Satisfactory	Bad

4. What is the frequency of private water supply during the lean and non lean period?

Lean Period		Non Lean Period	
Frequency	Quantity	Frequency	Quantity
Once in a day		Once in a day	
Once in two days		Once in two days	
Once in three days		Once in three days	
Once in a week		Once in a week	

5. During which months do you buy maximum water from vendors? Why?

6. What problems are you facing regarding water for the domestic use?

7. What do you think are the major reasons for the scarcity or shortage of water in your ward or in Darjeeling?

8. Who is responsible for day to day management of water supply in your ward?

9. Were you ever invited by the government department or municipality to discuss about water management situation in Darjeeling?

10. Are you satisfied with the management operation of water in your ward? **Yes/ No.**

If **No** then explain/ specify the reasons.

11. Can you put forward some suggestions or your views regarding the improvement/management of water situation in Darjeeling?
12. Can you put forward some suggestions for achieving sustainability of water in your ward or in Darjeeling?

APPENDIX- IV

SCHEDULE FOR COMMERCIAL /INSTITUTIONAL SECTOR

1) Name of Respondent:

2) Age: _____ 3) Gender: Male Female

4) Ward No: _____

5) Year of establishment: _____

6) What is the source of water supply?

i) Municipality ii) Springs iii) Private water vendors iv)
Others

7) Total amount of water used in a day for:

Drinking	
Domestic purpose	
Others (Please specify)	

9) How much do you pay as Municipality water tax monthly/annually?

10) What is the frequency of water supply?

Lean Period		Non Lean Period	
Frequency	Quantity	Frequency	Quantity
Once in a day		Once in a day	
Once in two days		Once in two days	

Once in three days		Once in three days	
Once in a week		Once in a week	

11) On the day of water supply for how many hours do you get?

Less than 1 hour	1 to 2 hour	2 to 3hours	3 to 4 hours	Above 4 hours

12) Is the frequency and quantity sufficient for you? **YES/NO**

If **NO** then how do you manage the additional requirements?

Natural Springs	Buy water from private water vendors	Manage with the available water	Any other (Please Specify)

13) What kind problems are you undergoing with regard to water for the smooth functioning of your business?

14) How do you rate the existing municipal water supply system in your ward?

Bad	Satisfactory	Good	Excellent

15) Are you satisfied with the existing Municipal water supply system? **YES/ NO.**

If **No** then can you suggest some remedial measures to improve the water supply situation?

16) What do you think is the main reason for the scarcity or shortage of water in your ward or in Darjeeling?

17) Who is responsible for day to day management of water supply in your ward?

- 18) Were you ever invited by the government department or municipality to discuss about water management situation in Darjeeling?
- 19) Do you feel satisfied with the management operation of water supply in your ward?
Yes/ No. If **No** then explain/ specify the reason behind it.
- 20) If the Municipality improves its water supply service and provides water, would you be willing to pay more for water? **Yes/ No.** Explain.
- 21) What aspect of water service do you think needs improvement in future?
- i) Quality ii) Maintenance iii) Service iv) Frequency
- iv) Pressure v) Others
- 22) Do you buy water from private vendors? **YES/ NO**
 If **YES** specify the quantity per day _____
- 23) What is the rate per Tank/Jar/Bucket? _____
- 24) How do you rate the quality of privately purchased water?
- | Excellent | Good | Satisfactory | Bad |
|-----------|------|--------------|-----|
| | | | |
- 25) During which months do you buy maximum water from vendors? Why?
- 26) What are the problems you are facing regarding water for your business?
- 27) Can you put forward some suggestions or your views regarding the improvement of water situation in Darjeeling?
- 28) According to your perspective what can be done for achieving sustainability of water in your ward or in Darjeeling?

APPENDIX -V

SCHEDULE FOR PRIVATE WATER SUPPLIERS (VENDORS)

1) Name of the Respondent:

2) Age: _____

3) Gender: Male

Female

4) Marital Status: _____

5) Caste:

6) Since when have you been residing in Darjeeling? _____

7) For how long have been engaged in this profession? _____

8) Do you have other occupation apart from this? YES/ NO.

If Yes Specify

9) What is the source of water that you supply?

10) State the approximate / average amount of daily water supply?

i. During lean Period _____

ii. Non lean period _____

11) Specify the type of supply you do:

i) House H ii) Commercial iii) Institutional
iv) All v) others

12) State the average number of household to which water is supplied per day.

Less than 10	10 to 20	20 to 50	50 to100	100 above

13) State the average volume of water supplied per household per day.

20-30 liters	30-50 liters	50-100 liters	Above 100 liters

14) State the average number of commercial/Institutions to which water is supplied per day.

Less than 10	10 to 20	20- 50	50- 100	100 above

15) State the average volume of water supplied for commercial/ institution per day.

20-30 liters	30-50 liters	50-100 liters	Above 100 liters

16) How much do you charge for every 20 liter? Has there been any increase in the price of water you sell? Yes / No. If Yes then since when and what were the rates?

17) Is the water subjected to any type of treatment before you supply? YES/NO.

If YES explain.

18) Do you make regular check to the condition of water supply source and reservoir/ tank?

YES/ NO. Explain.

19) What is the duration of your supply?

Once a day	Twice a day	Once in two days	Once in three days	Once in week

20) What is the highest amount of supply in a day? _____

21) Who are the major buyers? _____

22) What do you think is the main reason behind scarcity / shortage of water in Darjeeling?

23) How should we manage of water resource in the town?

24) Can you put forward some suggestions regarding the improvement of water supply / management Scenario in Darjeeling?

25) According to your perspective what role can general people/ Non-governmental government at various levels, can and should play in promoting sustainability of water in Darjeeling

APPENDIX VI

INTERVIEW SCHEDULE FOR MUNICIPALITY WATER SUPPLY INCHARGE

- 1) Name of the official: _____
- 2) Designation: _____
- 3) Discuss your opinion about water resource of Darjeeling.
- 4) How much volume of water does municipality consume every day?
- 5) Is the volume sufficient to meet the demand of people of the town?
- 6) Specify the average demand of water in the town? Is your department successful in catering the demand? Yes/ NO. If NO then how do you manage to fulfill the demand?
- 7) How many household does municipal water supply cover in the whole town? Explain.
- 8) During lean period how does your department manage to supply water for the town?
- 9) Does your department have the facility of waste water treatment plant? YES/NO. Explain.
- 10) Water metering is important in Urban water supply system does your department provide such facility? YES/NO. Explain.
- 11) Can you specify the charges or rate of water that is supplied to the municipal area? Are the rate same or has changed as compared to previous rate?
- 12) What do you think is the most pressing problem regarding municipal water management in Darjeeling?
- 13) How is your department trying to overcome these problems?
- 14) Has your department planned any changes regarding water management and supply system in Darjeeling? YES/NO .Explain.
- 15) What amount of revenue is generated in the municipality from water supply?
- 16) What are the factors affecting proper management of water in Darjeeling? Specify if any
- 17) According to your view what can be done to initiate better water management practice in Darjeeling?
- 18) What role according to your perspective can general people /Non-governmental organization/government at various levels, can and should play in promoting sustainable water management in Darjeeling?
- 19) Does your municipality organize any kind of seminars/workshops etc. to aware local people about the importance of water and its conservation? YES/ NO. Explain.