WATER RESOURCE MANAGEMENT IN SOUTH SIKKIM:

COMMUNITY PARTICIPATION

AND INSTITUTIONAL PRACTICES

A Thesis Submitted

To

Sikkim University

In Partial Fulfilment of the Requirement for the

Degree of Doctor of Philosophy

By

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July, 2018

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DECLARATION

I, Chhunu Maya Giri, hereby declare that this Thesis entitled **"Water Resource Management in South Sikkim: Community Participation and Institutional Practices"** submitted to Sikkim University is my own and original work. The contents 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 thesis has not been submitted by me to any other University or Institute. This is being submitted in partial fulfilment of the requirements of the **Degree of Doctor of Philosophy**, in the Department of Geography, School of Human Sciences, Sikkim University.

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This is to certify that the thesis entitled **"Water Resource Management in South Sikkim: Community Participation and Institutional Practices"** submitted to Sikkim University in the partial fulfilment of the requirement for the degree of **Doctor of Philosophy** in geography embodies the results of bonafide research work carried out by Chhunu Maya Giri under my guidance and supervision.

No part of this thesis has been submitted for any other degree, diploma, associate-ship and fellowship.

All the assistance and help received during the course of the investigation have been duly acknowledge by her.

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"Water Resource Management in South Sikkim: Community Participation and Institutional Practices"

Submitted by **Chhunu Maya Giri** under the supervision of **Dr. Sohel Firdos** (Associate Professor) of the Department of geography, School of Human Sciences, Sikkim University, Gangtok 737102, India

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AKNOWLEDGEMENT

"Thank you God for giving me the strength to keep going". I am grateful to you for all your many untold blessing upon me without which I could not have finished my Thesis.

Firstly, I would like to express my deep and humble gratitude to my supervisor Dr. Sohel Firdos, Associate Professor, Department of Geography for his consistence guidance, comprehensive evaluation, enthusiastic encouragement and useful critique throughout my research work. Without whom it was not possible to complete my Thesis.

Besides my supervisor, I am heartily grateful to the other teachers of the department for their immense support and valuable suggestions during the course. Similarly, my sincere thank also goes to Mr. Tulshi Sharma, Lab Assistant for his unconditional support for my lab work. Without whom my lab work could not have completed.

I thank all the staff member of Central Library (Sikkim University), Central Library Kolkata, Sikkim State Central Library, Gangtok who had helped me to access material for my research work.

My gratitude also goes to officials of the Department of PHE Government of Sikkim Namchi, Department of RMDD Government of Sikkim Namchi and Gangtok, Meteorological Department Gangtok, Department of Agriculture and Horticulture Government of Sikkim Namchi, Department of Forest, Headquarter Gangtok and DESME Government of Sikkim for providing me valuable secondary data and information related to my Thesis.

My colossal thanks goes to Dr. Bina Pradhan former Principal, Dr. P.R Poudyal present Principal and faculty members of the department of Geography, Namchi Government College who conceded me to complete my research work conveniently.

I am pleased to extend my gratitude to my few friends but important Mr. Purna Hang Subba**,** Ph.D Scholar, Department of Economic, Sikkim University, Mrs. Dawa Lamu Bhutai**,** Assistant professor, Namchi Government College for availing me constant and constructive support and aids. To Boot thanks goes to my student who had accompanied me during my field work.

I am very grateful to Dr. Chunku Bhutia, Assistant Professor, Department of Political Science, Burtuk Government College for proofreading my Thesis.

Lastly, I would like to express my gratitude to my parents, all family members and relatives for their moral as well as financial support throughout the study.

Sikkim University, Gangtok **Chhunu Maya Giri**

2018

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LIST OF ABBREVIATIONS

APL	Above Poverty Line
BCM	Billion Cubic Metres
BPL	Below Poverty Line
CGWB	Central Groundwater Board
CWC	Central Water Commission
DESME	Department of Economics, Statistics, Monitoring and Evaluation
FGD	Focused Group Discussion
GIS	Geographical Information System
GPU	Gram Panchayat Units
HH	Household
IAY	Indira Awaas Yojana
ICDS	Integrated Child Development Services
JFM	Joint Forest Management
LPG	Liquefied Petroleum Gas
MCM	Million Cubic Metres
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
ML	Million Litres
MLD	Million Litres per Day
MOWR	Ministry of Water Resource
NGO	Non Governmental Organization
NMC	Namchi Municipal Council
NRDWP	National Rural Drinking Water Supply Projects
OBC	Other Backward Class
PCB	People Credit Bank

PMKSY	Pradhan Mantri Krishi Sichayee Yojna
PWD	Public Work department
RCC	Reinforced Cement and Concrete
RMDD	Rural Management and Development Department
SC	Schedule Cast
SD	Standard Deviation
SMU	Service Management Units
SPSS	Statistical Package for the Social Sciences
ST	Schedule Tribe
SUG	Service User Groups
TBS	Tarun Bharat Sangh
UNCED	United Nations Conference on Environment and Development
UNDP	United Nation Development Programme
VWSC	Village water and sanitation committee
WSPHED	Water Security, Physical Health and Engineering Department
WWF	World Water Forum

CHAPTER I

INTRODUCTION

The fresh water on the earth surface is very limited as about 2.7 percent of the total water available on the earth surface is fresh water of which around 75.2 percent lies frozen in Polar Regions and another 22.6 percent is present as groundwater. The remaining is available in lakes, rivers, atmosphere, moisture, soil, and vegetation. According to World Health Organisation, less than one percent of the World's fresh water or 0.007 percent is readily available for human consumption (Chinnan 2009). With the rapidly growing population and their increasing demands, the pressure on this valuable resource is also increasing at an alarming rate. Over 1 billion people today cannot obtain enough clean water to meet their basic human needs (Jansky and Uitto 2005). The World Bank Estimated that by the Year 2025, 3.25 billion people in 52 countries will live in a condition of water shortage (Gopal 1999).

India has more than 17 percent of the world's population but has only 4 percent of the world's water. Groundwater resource forms the backbone of the Indian's water supply. Some 85 percent of rural water supplies in India is derived from groundwater (The World Bank 2010). In a large part of India, groundwater is supplied through wells while in Himalayan region springs and streams are a major source of rural water supply.

Himalaya, a huge reserve of fresh water feeds major rivers like the Ganga, the Indus, and the Brahmaputra, act as a backbone for the socio-economic development of the people residing both in high land and low land. The seasonal streams and springs are drying up day by day due to the climate change, land use change and lack of management which caused a water shortage for the domestic and irrigation to the people residing over the area. Hence, it is essential to manage this valuable resource

to sustain the livelihood of people. Biswas (2004) mentioned that almost all the developing countries including South Asian nations are facing the problem of the freshwater crisis not because of physical scarcity but due to the poor management system of available water resources. India is heading towards a freshwater crisis mainly due to improper management of water resources which has led to a lack of access to safe water supply to millions of people (Chinnan 2009).

I.1. Water Management Practices Prior to the Community Participation in India

The practice of water management in India is found prior to the advent of British in India. The Vedas and other religious text contain the moral, ethical, social values applied to water management during the pre-colonial Hindu and Muslim rule in India. In this period even the people were aware of the rainfall pattern, need of irrigation in the different ecological situation. During this period different water storage and supply infrastructures like a tank, well and channel used to be built by the order of the king. The king used to provide the revenue-free land to the villagers to build water tanks with the motive of increasing the agricultural prosperity. Apart from the water infrastructure developed by the Kings, villagers used to construct tank with their own initiative and used to take care of its maintenance. There used to be a small cluster of the village with one tank, which was under the control of villagers. Also, villagers used to construct water distribution canal to ensure equal distribution of water for both the upstream and downstream water user. However, this system of tank water management was indirectly linked to legal political ruler and other different administrative level. Such practice of water management was mainly found in the southern part of India. Such a system of water management is very similar to the present day concept of community -based water management system.

During the colonial period, the British Government started constructing the large-scale irrigation projects with the motive of getting instant benefit from the water development especially in southern states of India but was not successful. Later, the Government started maintaining the tanks established at the pre-colonial period and was directly controlled by Public Work Department (PWD). But this initiative also failed due to non-cooperation from the local community because the government was expecting involvement of villagers to give labour voluntarily in irrigation management system. Subsequently, many traditional irrigation management systems were brought under Government control and many of them were banned by the concerned department. As a result of it a number of water problems like water logging, drainage problem and loss of irrigation emerged. To sort out these problems, the British government undertook all these water projects and imposed taxes on the users.

After independence, the Government of India made a huge investment in water management for irrigation to overcome the food production shortage. Large-scale irrigation canals and dams construction were initiated in different parts of India. Even after independence the Indian Government continued the old rule which provided the Department of irrigation the authority to deal with the matters related to surface water development and management. Further, the Irrigation Department made strict water allocation rule to the user. Such a system led to the brewing of corruption between the officials and highly influential farmers and politicians in terms of distribution of water in their advantage and mismanagement of water resource (Naz and Subramanian 2010).

After such a situation the government realized the lack of awareness amongst farmers and initiated two programmes, one of which was to educate farmers about the

efficient use of water and the other one being the Command Area Development Programme to ensure the proper management of water. In this programme, farmers were involved in water management for irrigation. During the early 1990s, the Participatory Irrigation Management (PIM) was officially recognized as the best method for efficient water utilization for irrigation, equitable distribution and sustainable water service. Under the irrigation project funded by World Bank, thousand of water user associations were formed to take the responsibility of distribution of water amongst farmers, operation and maintenance and collection of water charge from the farmers. This was the first initiation of community participation in water resource management. Since Independence, the Government of India have been spending a huge amount for the construction of large-scale dams for drilled well and tube well, invested a large amount for the extraction of underground water and development of water infrastructures. There was no limitation set by the government for the withdrawal of underground water especially in southern and north-western part of India. Now government realized the diminishing level of underground water so, in the year 1992 central government passed a bill called Model Groundwater Control and Regulator Bill to set a limitation to the withdrawal of groundwater but was not successful. Further, in the year 2002 new water policy called National Water Policy 2002 was formulated to promote the equitable use of surface and subsurface water, water conservative and participatory irrigation management.

I.2. Water Governance

Water governance is a political, administrative and social system which manages the water resources of a country or state and provides water services to every section of a society. This system functions in relation to water-related laws and constitutional provision, which are different for central and state Government. Laws

related to surface and groundwater, legal provision for the allocation and use are different with different administrative setup. In India the responsibility of planning and management of water resource is with Union Ministry of Water Resource (MOWR). The next important administrative bodies are Central Water Commission (CWC), the Central Ground Water Board and National Water Development Agency which functions under Union Ministry of Water Resource. In state level, there are different departments under which both the regulation and allocation of water for the irrigation and drinking are carried out.

The state functions independently when exercising its control over the water resources. The role of the central government is limited to providing financial support and beyond this, it cannot make any water related law without the consent of state government. Sometimes if the interstate river issues emerge only at that time centre government does interfere. State, sometimes depends on the private agencies for the financial aid for water management.

The Central Water Commission was set up in the year 1945, since then it is functioning to control the river water, generate water economy, command over any kind of river development, and monitoring river volume. Likewise, Central Groundwater Board (CGWB) was set up in the year 1971. The function of CGWB is to monitor the groundwater condition, extraction of underground water for both irrigation and domestic purpose and set a policy for groundwater development. Shah (2016) has made an argument on the existing water governance of India especially on the functions of CWC, CGWB. His study pointed out that the present water governance in India was set up before 1975. At that time the availability and demand of water and socio-economic setup of society was different from today's scenario but the laws and policies related to water governance are still the same. Further, he has

argued that the system of CWC is lacking in interlinking the different discipline in water sectors as well as within the different sectors of water consumption like irrigation, domestic sector and availability of water sources like surface water with groundwater sector. Presently, all these sectors related to water management are functioning independently of each other. Furthermore, this study also argued that under existing water governance, discrimination on access to water on the different ground prevails and there is lack in transparency of information sharing related to water.

In this connection, He has put forward some suggestions on the requirement of reform in existing water governance. The major suggestions are formulation of New Water Policy based on the present scenario of social setup and water availability condition, CWC should function with partnership with the primary stakeholder and should be multidisciplinary where other social science and management discipline should be incorporate. Further, the new reforms in water governance must function according to the demand of the water user and should provide equal water to every sector of society.

The concept of community participation in the discourse of water governance emerged in late 1980s after the failures of state led and techno-centric approaches for water management. In these approaches the allocation and development of surface and subsurface water was under the control of the state or state used to govern all matter related to water. The failure of these approaches of the government for water management leads to the amendment of new constitutional provision for water management in early 1990s called participatory approach in water management. This constitutional provision provides much more participatory form of water governance at the local level (Cullet 2015). In this system of water management local stakeholders

and water users were involved in the water projects. After 1990s the community-based water projects have become popular and brought better outcome. In this way the change in the governance of water resources from the state-controlled management to community – based management have reduced the direct state responsibility on water management (Sultana 2015).

The National Water Policy 2002 was implemented in which the focus was given to the broader understanding of participation of beneficiaries and private stakeholder in water sector. The latest National Water Policy 2012 stated that the participation is a part of good governance and highlighted community participation in the management of water projects and services (Cullet 2015).

I.3. Community Participation

Abram (1971) defines community participation as "the theory that the local community should be given an active role in programmes and improvements directly affecting it".

Hamid (1991) define community participation as powerful ideas which refer to the process by which professional, families' community group, government officials and other get together to work".

According to Habraken (2000) participation has two definitions with opposite meanings; participation can either represent assigning a certain decisive role to the users, where they share the decision making responsibility with the professionals. The other type of participation is where there is no shift of responsibility between users and professionals but instead, only the opinion of the user is considered while making a decision.

In a very simple term, community participation means involvement of local community, social workers, and professionals in any developmental process and tries

to bridge the gap between traditional and modern knowledge and methods to conserve the natural resources to achieve a common goal for long-term sustaining.

Communities across the world are actively participating in managing their valuable natural resources such land, water and forest. In India, mountain people are traditionally managing their water resource for sustenance of their livelihood; people in other parts of the country as well participating in water project for both irrigation and drinking purposes. A participatory approach is considered as a panacea to combat all environment related problem and has been adopted worldwide in developmental projects.

I.4. Statement of the Problem

Sikkim, being a Himalayan state characterized with a steep slope and rugged topography, where maximum rainwater flows as a surface runoff causing less recharge of the aquifer. The rainfall pattern across the state is highly variable and out of the four districts located in Sikkim, South district is the driest district. A district wise average rainfall of five years i.e. from 2012 – 2016 gives a clear picture that North district with an average rainfall of 3006.62 mm receives the highest rainfall, followed by the East district which recorded 2475.06 mm. Similarly, the West district received an average rainfall of 2154.8 mm and the South district received five years average rainfall of 1999.6 which is lowest amongst the other districts of the state (Data computed from India Meteorological Department, New Delhi, available at www.sikenvis.nic.in).

Further, Namchi is located in the rain shadow zone of Darjeeling Himalaya where almost no rain occurs in the winter months (November to March) which makes the area water scarce. The less availability of rainwater cause low discharge of spring and drying up of the small streams which drains the area thereby further causing water

shortage in the area. The water scarcity problem not only affected the agricultural practices in the area but also has affected the domestic water shortage in both the rural and urban area of Namchi.

In addition to this, Namchi falls under drought prone area of Sikkim. Out of the eight droughts prone blocks identified by the Rural Management and Development Department (RMDD) of Government of Sikkim, the five falls in the South district that is Namthang, Melli, Jorthang, Namchi and Sikkip. The parameters which were taken for the identification of Drought prone area are as follows;

i. The area located on the ridge top

ii. The area which faces drinking water problem in lean season

iii. The area which falls in rain shadow area

iv. The area have little forest or no forest area in the upper catchments

v. The prevalent land use is not amenable to water conservation

vi. The general terrain is steep and rocky.

The above-mentioned criterions by Rural Management and Development Department, Government of Sikkim are not much similar to that of the criteria set at the National level. The criterion followed by the Indian Metrological Department and Central Ground Water Board for the identification of drought-prone area is different. In the national level, drought has been classified into different categories on the basis of rainfall and availability of water. It is divided into Metrological drought, Hydrological drought and Agricultural drought. The metrological drought is identified based on rainfall deficiencies. The hydrological drought identified based on deficiencies in surface and sub-surface water supplies causing shortage of water for normal and specific needs. While an agricultural drought is identified based on

rainfall i.e. the area receiving rainfall of 50mm for six successive weeks and 80 percent of crops grown in Kharif season is identified as agricultural drought.

Overall in India, the area receiving rainfall between 750 mm and 1125 mm is considered drought-prone while area receiving less than 750 mm is considered chronically drought-prone. By observing these criteria at the national level for identification of drought-prone area, only the criteria of rainfall deficiency and water shortage problem are same. So in such a water scarce area, it is essential to know how the local communities are managing their domestic water requirements.

I.5. Objectives of the Study

1. To analyse the availability of water for the purpose of drinking, irrigation and tourism in South Sikkim.
2. To analyse the access, modes of use and mechanism of participation of different communities in water resource management.
3. To analyse the role of institutions in allocation, distribution and sustainable use of water resources.
4. To analyse the role of women in water management.
5. To examine the government programmes implemented for the water management.

I.6. Research Questions

1. How are the rural and urban people accessing water in Namchi?
2. What is the purpose of consumption of water in Namchi?
3. How the communities are participating in water management?
4. How many days people engaged in water management per month and what is the time duration of their participation in management work.
5. Is there any gender gap in participation in water management?

6. What is the role of the institution in allocation and distribution of water in Namchi?
7. What is the public opinion on government schemes implemented for water supply in Namchi?

I.7. Methodology

This section deals with the methods used for the selection of sample, and collection of primary data.

I.7.ii. Sampling

In order to select the households for survey, the following steps were followed. Firstly, the data on the number of Gram Panchayat Unit (GPU) under Namchi block and its profile was collected from the Directorate of Economics, Statistics, Monitoring and Evaluation (DESME), Government of Sikkim but data was not accurate and adequate. Subsequently, the data on total number of GPUs was collected from Block Development Office Namchi, South Sikkim.

After the collection of information of GPUs from Government office, a pilot survey was carried out twice in all the GPUs of Namchi. In the first pilot survey, following information have been collected: water availability status, mode of access of water, the process of management, Government initiatives for water security in the village, farming practices, social issues in water access and formation of water committee through interaction with the people and by observation. After this survey five sample GPUs were selected on the basis of availability of water in the village, intensity of water problem, location of households with respect to water sources, existing water management committee and water management practices of village. In the second pilot survey data was collected on following variables; the name of the head of a family and house number collected from the respective Panchayat office to calculate total number of households in a GPUs. On the completion of two pilot

surveys, computation of total households in all the villages under selected GPU was done and finally five sample villages were selected by applying purposive sampling method. It was found during the field survey that many houses especially in Rong and Singithang village were lying vacant. For the selection of Sample in Namchi Municipal Area, the data was collected from the census of India 2011 and was verified from Namchi Municipal Office. There were seven municipal wards under Namchi Municipal Council (NMC) from which Upper Singithang was selected as sample. The reason for the selection of this particular Panchayat Ward is because the sample had to be selected from the area which consists of a maximum number of commercial and residence houses. From this selected ward 15 percent of the total household was selected as sample for the present study. Altogether 280 households were covered to conduct the present study, 180 from a rural area and 100 from an urban area.

Sample households have been drawn from five villages and one municipal ward of Namchi block of South Sikkim as per the data given in the Table below:

Table 1.1: Sample Frame

Name of the *GPU and **Municipal Area	**Selected Panchayat Ward**	**Total number of Household**	**No. of Households Surveyed**
Rangbul	Rong	65	33
Maniram Phalidara	Lower Phalidara	49	39
Kitam Manpur	Upper Kitam Ward	52	38
Sorok Shyampani	Upper Sorok	38	30
Mikkhola	Singithang	68	40
Total		272	180
Namchi Municipal Council	Upper Singithang	661	100 (15%)

Total sample selected	-	-	280

Source: Gram Panchayat Office (Rongbul, Phalidara, Kitam Manpur, Sorok Shyampani, Singithang), *GPU- Gram Panchayat Unit.

Primary data has been collected by following methods.

I.7.iii. Interview Methods

Interview was conducted in each of the sample households with structured questionnaire to collect data from the water user community about availability of water, problem of water scarcity in the locality, mode of access and mechanism of use of water resource. Further, information about their perception on water management, the way they are participating and managing water resource for household as well as other uses and their perception on the government implemented scheme for water security. There were no specifications of the group to interview. However, from more than 60 percent of surveyed households females participated with full of enthusiasm in interviews and shared the water related problem they are going through, since they are the ones who manages household water requirement.

Separate interview was conducted for the collection of information from Government officials from different Departments, Like Divisional Engineer and Additional Engineer from Water Security and Physical Health and Engineering Department (PHED) Namchi, Rural Management Development Department (RMDD) to know about the types of water management scheme adopted and implement in the study area and their future steps for water security in the area.

I.7.iv. Focus Group Discussion

The focus group discussion method was also used in this study. Overall two focus group discussion was conducted, in the first FGD both female and male, (old age group) were the participants and the second FGD was conducted amongst only women. The major issues which were discussed during FGD were social problems

related to water access and use, issues related to the representation of women in the water-related scheme and committees and, their interest in water resource management.

I.7.v. Observation Method

This study was also based on the direct observation of the field for the collection of data. Observation was carried out in all the villages during field survey. I went along with the people to water source area to know about the source condition. Similarly, in Upper Kitam I stayed in my friend's house without informing the main purpose of visits to know about the water distribution system to the households and to observe the activities of villagers in water tank area, as her house was just in front of government community tank. Likewise, in every surveyed household, I checked the availability and condition of water storage facilities both private and government provided. I stayed in all surveyed villages to know about the purpose of water use. In the Upper Kitam, Upper Sorok and Lower Phalidara village I visited the field in winter season to know who collects water for households (male or female member of family). Further, I visited the water source with the villagers while they were involved in water maintenance work to observe their timing of participation. The observation was also made through interaction with the people to know about their perception towards the Government water service provider. The water harvesting system was closely observed during the field survey. In the urban area I observed for around eight years about water distribution system, how people are adjusting with such limited water, how people collect water from outside sources and illegal activities of water fitter.

I.8. Data Base

Data required for the study was generated and collected through various primary and secondary sources. Primary data was collected through interview method, focus group discussion and direct observation.

I.8.i. Secondary data was collected from the following sources:

- Census of India, 1991, 2001, 2011, Sikkim Census Hand Book, Series 12, Part XII - B
- Department of Economics, Statistics, Monitoring and Evaluation (DESME), Government of Sikkim
- Rainfall data from Meteorological Department Namthang, South Sikkim
- Rainfall data from the Agriculture Department Namchi, South Sikkim collected from automatic weather observatory, Maniram Phalidara, Namchi (Station ID A0AD4E5A).
- Information about water management project and programmes from Rural Management and Development Department, Government of Sikkim.
- Data and information related to Water supply and water distribution system in the municipal area of Namchi, Information on water taxes from Water Security and Physical Health and Engineering Department Namchi, Government of Sikkim.
- Collected GIS data on drainage of South Sikkim and Namchi from Department of Forest, Government of Sikkim, Gangtok
- Collected detail information about Gram Panchayat and Village information from Block Development Office, Namchi South Sikkim
- Department of Irrigation, Government of Sikkim, Namchi South Sikkim.

- Collected data about the land size holding classification from Department of Agriculture, Government of Sikkim, Namchi South Sikkim

Parameters selected for analysing the socio-economic condition of the people

I. Education level

II. Monthly income of family

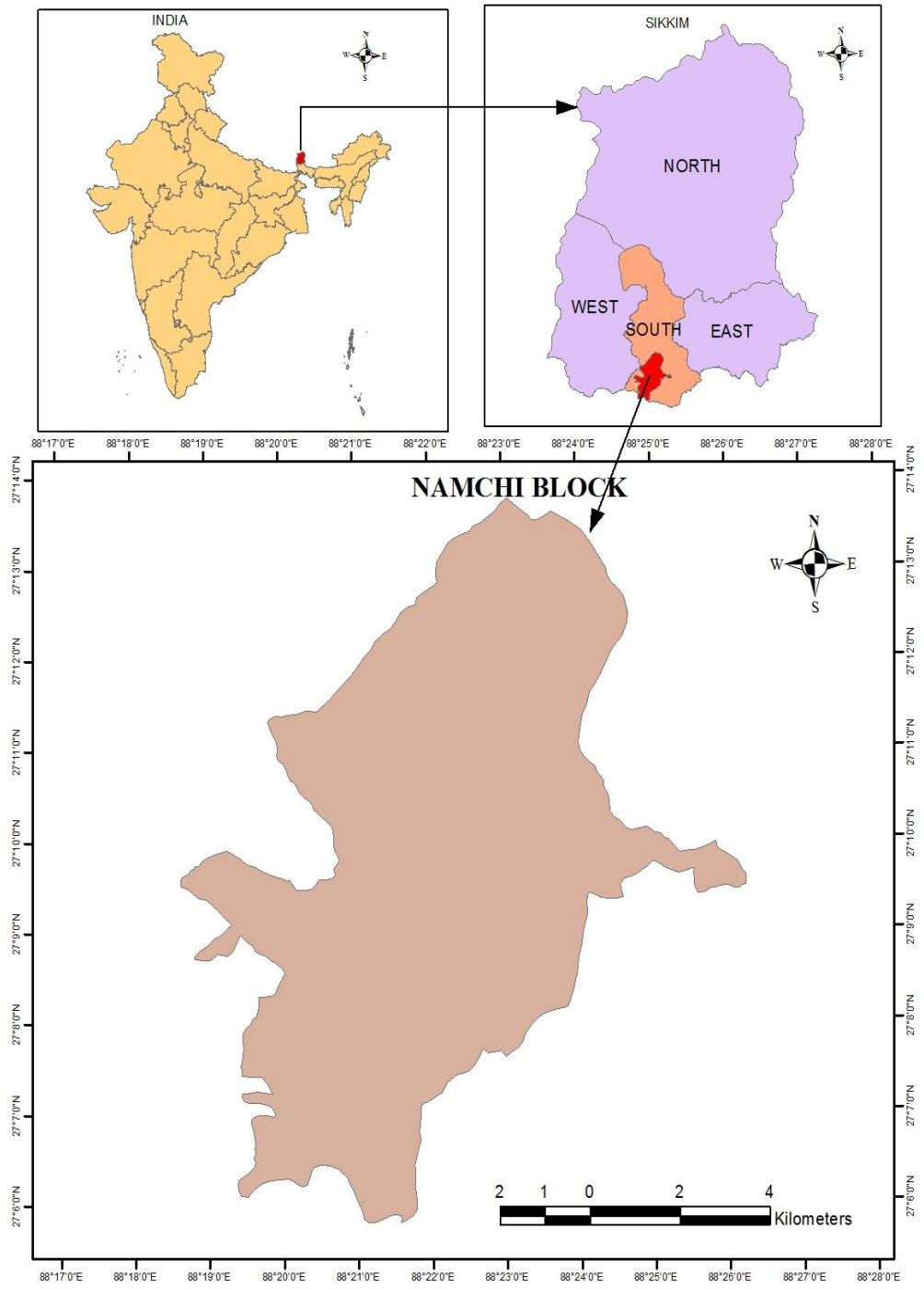
III. Occupation

Purposive sampling was used to collect the information from the various community and key person of the village, their experience, and their traditional practices of water management in the village.

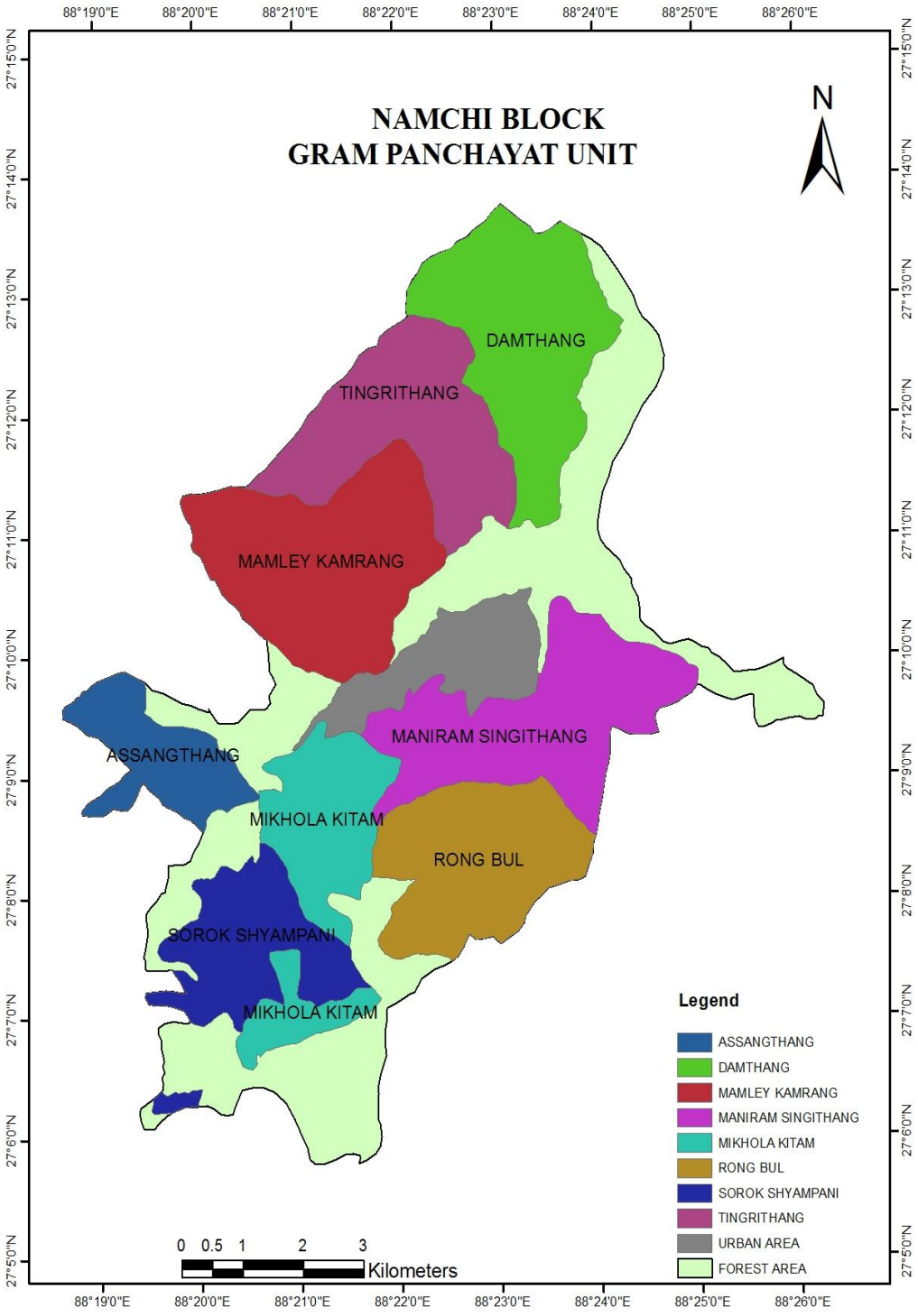
I.9. Analyses of Data

The location map and maps of physical aspects of the study area were prepared by using Arc GIS software. Finally, the data collected from both field and secondary sources were transferred to the computer for analysis. Microsoft Excel and SPSS were used to analyse the data. In SPSS descriptive analysis has been run. In excel computation of average, percentage, Standard deviation has been done. Ratio scale was used to know the proportion of female participation to male participation in water management. Data has been presented on the graph, chart and in a bar diagram

LOCATION OF THE STUDY AREA



Source: Prepared by Author, adapted from RMDD, Government of Sikkim, Projected-UTM WGS 1984-Zone 45N



Source: Prepared by Author, adapted from RMDD, Government of Sikkim, Projected-UTM WGS 1984-Zone 45N

I.10. Study Area

Sikkim a tiny Himalayan state lies between 27° 4' 40" N to 28° 7' 48"N latitude and 88°E to 88° 55' 25"E longitude. Sikkim covers the total geographical area of 7096 sq km, which constitute 0.2 percent of country's land area. Sikkim is characterized by rugged topography and a steep slope with elevation varies from 300 meters to 8998 meters. Water resource in Sikkim is in the form of glaciers, lakes, rivers, streams and springs. River Teesta and River Rangeet is the two main river system of the state. The climate of Sikkim varies according to the altitude from subtropical to alpine. The state receives an annual rainfall of 2000 mm to 4000mm and the average annual temperature is 18º C (64 ºF).

Sikkim is one of the least populated state of India with a total population of 6, 07,688 as per 2011 census which constitutes 0.05 percent of country's population. It is mainly inhabited by three main ethnic groups, Lepcha, Bhutia and Nepali.

People of Sikkim are highly dependent on agriculture, and this is the sector which consumes 98 percent of the water for irrigation. Further, as per Rural Management and Development Department report more than 80 percent of rural people are depending on the spring water. Hence to maintain the sustainability of agriculture, the livelihood of the people and developmental process, an individual needs to think about the management of water.

The state of Sikkim comprises of four districts viz East, West, North and South. Amongst these four districts, the North district is largest in terms of area and the East in terms of population.

Selected Study Area

STATE	Sikkim				
DISTRICT	South				
BLOCK	Namchi				
GRAM PANCHAYAT UNITS (GPU)	Rangbul	Maniram Phalidara	Kitam Manpur	Sorok Shyampani	Mikkhola
MUNICIPAL AREA	Upper Singithang				

I.11. Rational of the Study

This study was conducted in Namchi one of the revenue blocks of South district of the state. The reason for the selection of the site was because this area falls under rain shadow zone of Darjeeling Himalaya, rainfall is very less throughout the year. In the winter months (November to March) the area recorded no rainfall for several years, which makes the region one of the most water-scarce in the state. It is also one of the drought-prone areas of Sikkim which face acute water scarcity problem, especially during winter. The driest month is December with less than 6mm rainfall and wettest month is July with an average rainfall of 740 mm. The problem of water shortage has forced the people to change their farming practices in the area. In such a water scarce region it is essential to know about the community's effort and achievements to manage their water resource.

I.12. Organization of the Study

This study has been organized into seven chapters. The first chapter gives the significance of the study in the form of global water availability issues and its future concern, importance of community participation approaches in water resource management, statement of the problem, objectives, research questions, methodology database, analyses of data and study area and lastly the organization of study.

The Second Chapter gives review of literature survey on water management system and community participation approaches in water resource management.

The Third chapter deals with physical, demographic and socio-economic characteristics of rural area. The first section of the chapter contains the physical aspects of Namchi and the second section deals with the demographic and socio-economic characteristics of rural area of Namchi.

The availability, access and mode of water use in the rural and urban area of Namchi are separately discussed in chapter four and chapter five respectively.

The Fourth chapter deals with the water resource availability and its importance in Sikkim in general and South Sikkim and Namchi in particular. Further the chapter contains the river system in South Sikkim and Namchi, the rainfall analyses of South Sikkim and Namchi Block and analyses of census data on drinking water source availability and its types in Namchi. In addition, the chapter describes the field data on the water availability status in rural area, water source availability, mode of access of water, water connection availability, types of connection, availability of supply, timing of water supply, availability of storage facility, type of storage and capacity, purpose of use of water, water fetching practices, Rain water harvesting practices. At last the chapter has been summarized.

The Fifth chapter presents the availability, access, mode of use and management system of water resource in urban area of Namchi (Namchi Municipal Area). First part of the chapter deals with socio- economic characteristic of sample households of urban area followed by the analyses of government report on water supply system of PHED, water distribution process, water text in urban area. The second part of the chapter contained the analyses of field data on household level water source availability, access, water connection and types, supply, number of day

per week water supply, timing of supply, availability of water storage facility, mode of use of water, public opinion on quantity of water supply, public satisfaction on water supply system in NMC, water fetching practice, rainwater harvesting system and its use in urban area and summary of the chapter.

The Sixth chapter presents the community participation in water resource management. The first part of this chapter highlights the relevance of community participation in water management. Further, the chapter contains a brief historical background of people's efforts in environmental conservation in general and water management particular in India and historical background of community participation in water resource management in Sikkim. The second part of the chapter presents analysis of field survey data of both the rural and urban area on participation of community in water management, mode of participation, number of days and time spent by people in water management work per month. The chapter explored how the local communities are participating in water management individually and through different formal and informal committees. It further contains structure, system of operations and functions of different water management committee formed by villagers. In the concluding portion the chapter presents the role of institutions in water allocation and distribution in both rural and urban area of Namchi.

Chapter Seven presents the finding, conclusions and suggestions.

CHAPTER II

Review of Literature

This chapter presents the literature survey related to the water resource management; the main focus has been given to cover the literature on community participation on water resource management, brief historical analysis of approaches to water resource management and the discourse on water management. Further, the importance has also been given to bring into light how the communities/ local people are participating in water resource management in different parts of the world in general and women participation in particular. The available literature has been organised in different themes and subthemes which are presented below.

II. 1. Approaches to Water Management:

The shift in the approach to water management

Approach	Year	Content
First Shift (techno-centric model)	1950– 1960	Emphasized on technology to find a sustainable water supply.
Second Shift (technology investment-centric model)	1970- 1980	Establishment of state-owned companies, technology investment-centric model, disregarded traditional knowledge and practice of water management.
Third Shift (debates on water as economic goods)	1980	Treating water as economic goods, water right, and right to water as a fundamental right.
Participatory water management	1990	Involvement of farmer, water user, in decision making, planning and maintenance in irrigation management.

The shift in the approach to water management and supply has been seen over the last five decades; the first shift took place in the 1950s -60s which showed the increasing dependence on the technology to find the sustainable water supply. In the 1970-80s the second shift in the approaches to water management occurred across the world. During this period, the separate state-owned companies for water supply and management were established. Further, in this period, the technology investment-centric model was popular and had disregarded traditional knowledge and practices of water management; this resulted in the separation of communities from taking care and ownership of water system.

From the 1980s onwards, debates focusing on treating water as an economic goods occurred throughout the world, this idea of considering water as economic goods has also been supported and explained in Dublin Statement (1992). However, this idea challenged the free provision of water supply hence, again the debates focusing on the water right and right to access water as a fundamental right emerged.

From early 90s new approaches to water management system called participatory approaches have been practising across the world. In this approach, focus is mainly given to the community and citizen-centric mode of water management, which means a system where farmer, local people and water user communities are involved from the planning to discussion making process of water management. This system is also known as a Community-based water management system.

Participatory approaches refer to the absolute involvement of local communities in any specific programme, beginning from appraisal to planning, implementation, monitoring and evaluation, sustainable operation and maintenance (Negi 2001).

It has been realized after independence that technology, government and other donor agencies alone cannot provide the solution of water resource management without the involvement of the farmer, water user, in decision making, planning and maintenance which led to the introduction of participatory irrigation management in India. Since then the participatory management evolved. Participatory natural resource management is an important approach for the proper management of natural resource, it is also an important tool for the solving the environment related problems. The key documents such as European Water Framework, Directive U.S. Clean Water Act, Principle 10 of the 1992 Rio Declaration on Environment and Development (UNCED) emphesizes on participatory water resource management and has stated that environment issue such as water management is best handled with the participation of all concerned citizens. In case of drinking water, sectoral reform with decentralization was first introduced in 1999 in 26 states of India in the form of Swajaldhara. At first, this sectoral reform in water resource management started from a southern state of India especially in the state of Maharashtra, Tamil Nadu, Andhra Pradesh where focus has been made to the irrigation management by forming Water User Association (Sangameswaran 2006).

Xing (2008) mention that public participation in water resource management was first introduced in the form of participation by social groups and cooperative organisation and this initiative became successful in enhancing farmer's economic condition, strengthening the tie between water supplier and water user community, improved in the project maintenance, enhancing irrigation cover, promote water supply.

In Himalayan states, a number of community headed-movement for natural resource management took place such as Chipko Movement, Swarjawaldhara, Bari

system etc. Some community-based natural resource management projects, initially developed under local conditions, have become a model followed worldwide.

II.2.Discourse on Water Management:

The scarcity of water resource for domestic, irrigation and other purpose has led to various water related social conflict, which forced the academician as well as policymakers to study the water resource in different aspects and dimension such as right to water, water as an economic good, upstream and downstream issues, social and economic issues on access to water and different approaches to water management. Today the problem of proper water management is a global issue and has become a major discussing point from the higher to a lower level of policy framing.

II.2.i. Right to water

Gleick (1999) argue that the access to a basic water requirement is a fundamental human right which is also indirectly supported by the International law, declarations and state practices.

Ramaswamy (1998) has mentioned that planning for water development and management should be based on the full participation of communities, NGOs etc and access to water should be considered as a basic human right but in the context of the industrial and irrigation use, it has to be recognized as a social and economic good.

Sagameswaran (2007) studied right to water, with the question like whether the right to water involves any duties on the part of the right holder, what kind of needs should be considered within the scope of the right to water (household, personal, drinking, livelihood). It is argued here that water should be treated as economic goods which would result in improved efficiency, equity and sustainability.

Sangameswaran (2009) mentioned that Pani Panchayat Scheme initiated in Maharashtra has not only brought improvement in the agricultural productivity, increased food security and the living standard but it also helps to provide water rights to the landless.

Saleth (1994), Brownstein (2009) argues that to bring an economic equity in the water sharing in Pani Panchayat system, individual water right/conservation credit needs to be transferable or rentable (rent in/out) same as carbon trade, so that it can help to reflect the scarcity and use value of water resources and also both the transferor and transferee can get the advantage of percentage which can be used for further investment in conservation and water infrastructure improvement.

Water right of Cabanocode community of Colca valley of Perci's South highland had been granted water right by the government when people illegally access water from the government constructed canal. After this water management system of Cabanoconde has followed the state model with the concern and participation of local community. It is argued here that planning for water project should be in co-operation and participation of water user Paerregaad (2013).

II.3. Social Issues in Water Resource Management:

II.3.i. Study in International context

Straub (2011) has tried to examine the reason for conflict among the water user group and water shortage in south Bali, Indonesia. It has found that power relation in terms of access to water and unequal supply of water for irrigation by the water project was the root causes of conflict and water shortage rather the drought.

Boaky and Akpor (2012) have investigated the extent of participation of disadvantage community in catchment management and also examine whether the disadvantaged community finds their participation meaningful in the Catchment

Management Forum through qualitative research approach and use of primary and secondary data. The study found that the extent of participation of the disadvantaged community in Msunduizi river catchment in South Africa was low, further this community did not find their participation meaningful in management forum. The way in which the organisation presented the information to the people was technical in nature and hence it was found not understandable to the people. Boaky and Akpor argue that public participation has been established in literature and legislation only. The suggestion imparted here is that prior to the establishment or start of any scheme/project for public development by either government or non-governmental organisation, it is essential first to emphasis on the development of skill and capacity of the participant to make their participation meaningful, especially the disadvantage community.

II.3.ii. Study in National Context

Naik (1997) has tried to identify the factors that influence the extent of community participation in Joint Forest Management, through an empirical study and have found that marginal profit, household are expected to get from the Joint forest management was the main factor which determines the level of participation. The higher the profit shares of a household the greater the level of community participation.

Sampat (2008) studied the implication of Sawajaldhara scheme for rural water supply in Rajasthan. The case study revealed that the wealthy family who could pay the initial cost had access to water from the scheme and those who could not afford were out of the scheme and were not benefited by the scheme. It was found that Sawajaldhara scheme failed to bring social equality in the right to water access, especially to the disadvantaged group in rural Rajasthan.

Reilly and Dhanju (2013) have analysed the social issues of water supply project in rural Rajasthan.The focus of the study was to explore the geographic research on neoliberal water governance and cast processes in modern India.Where it has been mentioned that 'The Our Water Project' has created social inequalities in Rajasthan as, only the wealthy and upper caste family were benefited with the project and the village water committees were formed only by the upper caste people.

Loftus (2014) has explored the social inequality in access to safe and sustainable drinking water. He argues that to bring the water scarcity issues in the mainstream policy farming, it is essential to maintain the relationship between those who have a good knowledge of water politics and policies and those who are guided by others.

II.4. Community Participation in Water Resource Management

The role of community and their participation in water resource management will be done by documenting some successful experience and mode of community-based water management systems in the different state of India and world in general. Community participation means direct involvement of ordinary people in local affairs, (Midgley 1986). The local communities are credited with having a greater understanding of as well as interest in their local environment and thus seen as more able to manage natural resource through local or traditional practices (Leach 1999).

Feachem (1980) mentioned that community participation in any water related project can improve the project by improving designs, reducing costs of construction and reducing the cost of operation and maintenance.

Upadhayay (2002) has explored the developing legal perspective on participation water management and some of the water user associations, watershed association, and Panchayati Raj institution.

There are number of studies as evidence which shows the success and sustainability of the developmental project particularly related to water resource management through community participation.

II.4.i. Community Participation in Water Resource Management; The Asian Context

Peruy and Dixon (1985) have explored Weir system of water diversion initiated by local people of North Thailand where local people along with the support of the institution could successfully increase the water supply in the village.

Sutawan (1990) has studied the community-based irrigation system in Bali Indonesia. The study have highlighted the community water management system wherein the local community have jointly formed local administration called "Subak" for the allocation and distribution of water resource in Bali. This local administration has succeeded in equal allocation and distribution of water to the people.

Barenstein (2008) has highlighted the endogenous water resource management system for irrigation practice in Sonar Hoar, Sunamganj district of Bangladesh. The villagers collectively developed "Done" System to transport the water from the central reservoir to the channels and from the channels to the field for paddy irrigation. The system operates with the social capital generated by a collection of the fund from the villagers. Barenstein further describes another indigenous water management technology called Cross-Dams, practice in all most all the part of Bangladesh. In this practice the bamboo pole, bamboo mats and banana trees are used to retain the surface water and are used for different purposes such as irrigation, domestic, drinking and water for cattle.

Karimi (2006) has brought into light the local community water management system of Baruah Bukik village of Sumatra, Indonesia, where the local people have

established their own water management system with the help of self-generated fund. The system comprises of Service management units (SMU) and Service user Groups (SUG), where every household has to register with the initial payment of (Rp 20,000) to access with the service and a monthly fee of Rp 4,000 or Rp 1,500 in cash plus 1 kilogram of rice. Of the total collected fund, 30 % were used to run the system and remaining 70% deposit in People Credit Bank (PCB) for the future management, operation and rehabilitation of the water facility at the time of requirement. In another village, people have a tradition of participation called Manangkabau, in any project which is benefited to the village community. The tradition of participation is so strong that any developmental project sanctioned to the village, requires the initial approval of the communities firstly it has to be approved by the communities.

II. 4. ii. Indian Context

Negi (2001) has mentioned that tank and water harvesting structure constructed under the integrated watershed management project in Godam village in Shiwalik hills of Panchakhua district and Kanali village in Yammuna Nagar district through the local community's participation had positively impacted on the socio-economic condition of the villagers and also saved the water fetching time of women.

Dabral (2002) has brought into light the indigenous soil and water management system practice by the people of North Eastern States of India in detail such as, Apatani water management system of Arunachal Pradesh, where water has been managed for multipurpose use such as irrigation paddy-cum-fish culture by the local communities with the help of pine tree trunk and bamboo. Similarly, in Meghalaya Bamboo drip irrigation system practised by the local tribal framers, where water has been carried by using bamboo channels especially to irrigate betel vines plant by drip drop at the base of the crop. Likewise, in Mizoram, local communities

have developed a rooftop harvesting structure for drinking purpose. In Nagaland farmer of Khoima, practice bench terracing with continuous flow irrigation for the conservation of soil and water.

Sharma and Kanwar (2009) have brought into light the indigenous water conservation system practice by the local communities of Himachal Pradesh in detail such as *Baudi, Nawn, Chhrudu, Khatri, Khad, Nala* etc.

Rawat (2009) has thrown light on the traditional water harvesting system of Kumaun Region in detail. In Kumaun region the main systems of water harvesting were *Guls, Nalas, Dharas, Lakes, Kund, Khal, Simar* and Water Mill and have mentioned that these technologies are still providing a significant proportion of water requirements of the people.

Bhamoriya (2011) has explored the traditional water management system of Himachal Pradesh where a local community with the joined efforts has designed a unique method of water management system where melted glaciers water is being shared through a channel called Khuls. The management and maintenance of Khuls were done by the communities, where the sharing of water was according to the landholding for a fixed period of time in rotation manner hence, this led to the emergence of institution locally called Bari system which means turn system.

Similarly, Bon (2000) has explored efforts of local people of Dhamla, Himachal Pradesh for the irrigation water management. The Khul (channels) are constructed by the local people for diversion of water from the stream, springs and river to irrigate the field. The annual maintenance and repairs are done by the irrigation user groups, every household has to participate as labourer on a voluntary basis and the user group collects funds at the time of requirement. If in case any

household failed to contribute in the share, they can be sentenced to a monetary fine or be imposed a penalty within a set of granted sanctions.

Mishra, Nayantara and Rucha (2008) studied the community-based water distribution system called Damasha in Karnataka and self initiated Tank Management system in Maharashtra. Dhamasha model was run by the villager alone without any involvement of Panchayat and other governmental and non-governmental agencies. In this system the tanks were the main source of water for the irrigation. At the time of water scarcity, the capacity of tanks to irrigate the field is reduced. So to maintain the equitable distribution of water and to cope-up with the scarcity period, villagers practiced Damasha. For each tank, two members from separate family were nominated as Neergatti (one who distributes water by putting obstructions in the right places). Monthly payment for Neergatti was not in the form of cash but as in the form of 30 bags of paddy per annum and some other product. The system of management was such that villagers have themselves fixed the proportion of land one farmer should cultivate at the time of scarcity and availability. At the time of scarcity, villagers were allowed to cultivate only 10% of their landholding by using tank water. Another fact of the system was that farmers, whose land was far off, have got land near the tank for temporary cultivation. This water sharing practice had helped to irrigate a cultivable area of about 15% during water scarcity and 25% during its full capacity. The total of 200 farmers was benefited by this system and even the poor farmers were benefited by cultivating a piece of land with assured water supply to sustain their life. The Dhamasha model was practiced from ten decades. This system reflects the extent of cooperation among the villages and their respect for traditional values. Another, case study has been done on the self-initiated collective system for Tank management in Maharashtra. In this study it was found that villagers have

formed a committee and well-defined rules for the proper management and equal supply of water to all the communities. The committee executed a number of tasks such as Monitoring of irrigation, fixing of water charge for a different season, a collection of water charges, conflict resolution and maintenance and repair of the tank.

The case study of Pimpalanare village of Maharashtra reveals that self-developed model for water management through irrigation tank not only helps to fulfil the household water need but also helped to grow more crops and has improved the living condition of the people (Mishra 2009).

In Assam, Bodo community practices a traditional water management system called Dong System. It has been said that this system of water management has brought a positive change in the water conservation and management and has also been able to bring social equality and cooperation in the society (Satya and Cronin 2013)

The evolution of traditional method of water management and harvesting system by the community in Kumaun region, where eco-friendly technique had been adopted by the community along with the Department of forest to manage the Nalaus. The study shows that this technique not only saved 60%-70% of wastewater but also reduced the water collecting time of local resident. It is argued here that such type of innovation works can not only help in fighting against the water scarcity of the Himalayan region but will also provide safe and hygienic drinking water to users (Sharma and Joshi 2014).

In Darjeeling, artificial irrigation is common in Tarai region whereas in hill springs called Jhoras are the main source of water. In Sikkim, local people have evolved efficient water harvesting system together with land management.

Construction of water canals, regulations of water flow and drawing of drinking water were traditionally done through community participation. The common sources of water for drinking are springs, streams and *Kholas*. (Irrigation Engineering Principles, Version 2 CE IIT, Kharagpur).

II. 5. Institutions and Water Management:

Empirical Studies from International Context

Heyd (2004) has analysed, to what extent the constitutional right for participation has been put into practice in Thailand. The objective of the study was to analyse the state of participatory water management in north Thailand. The research question framed for the study was: who are the people and Organization that have an interest in water management in Mae Sa watershed? What is the interest of local people in water issues and what strategies do they pursue to achieve their aim? Methodology for the study was a qualitative approach, review of the literature, semi-structured interview, field observation and group discussions, rankings to analyse the people perspective to government agencies and people attitude towards change in water management. The Major outcome of the research was that the people of that watershed region were relying on their own regulation for water management. The attitude of government agencies to the people, ethnic minorities were negative as they do not have confidence in their capacities to manage the resource. It is argued here that government school and university need to extend their curricula by modules on participatory resource and development.

Kgathi and Ngwenya (2005) examined the impact of community-based natural resource management on sustainable development in Ngamiland, Botswana over ten years. The study found that community-based natural resource management programme has made a sustainable way in strengthening the local institution,

empowered local communities and improved the livelihood of rural communities; also this programme leads to the infrastructure development in the village.

Sultana (2009) has brought the debates on nature-society geography and development geography. He has analysed, the role nature plays in the development process by shaping and challenging the practice of community participation in water resource management. He has suggested that scholar studying community and participation need to pay greater attention not only to gender and spatial power relation but also to the importance of geographical location and agency of heterogeneous nature of water management and development. The methodology which was followed for the study was extensive field survey of rural Bangladesh carried out between 2003-2005, involving participation observation, case studies, focus group discussions and 232 in-depth interviews with men and women.

Xing (2008) has attempted to monitor the seasonal variability of runoff in Xizhuang watershed of China and also attempted to answer the question like who is affected more by great seasonal runoff and what management options are available to overcome a period of shortfalls in water resource. The methodology which was used for this study were metering and dilutions method to measure water level and discharge, testing of water quality by collecting water samples, interview method has used for the collection of information from affected communities. The finding of the study shows that limited access to water was the main hindering factor in improving the standard of living in the mountainous watershed and midstream and downstream people are more affected by seasonal runoff. This study suggested that integrated watershed and water harvesting technology are essential to achieve high water productivity and high rural income and decentralization of decision making power to locally elected committee are all essential to identify the local issues and concern.

II.5.i National Context

Pacey and Cullis (1986) have highlighted, how the Gram Gourav Pratisthan (Village Pride Trust) a water management Project in Hinterland of Mumbai became successful to bring back the local people who migrated to urban areas, minimize the flow of migrant, and increase the livelihood of local people. The project provides an opportunity to people to participate and benefit from the project. Villagers with their own effort formed number of water management committee and had joined the project for the management of water resource of the village.

Dhamdhere (1986) have studied Joint Water Mangement System called Phad System of Dhule and Nasik District of Marastra. The Phad system was formed by the cooperation of government agencies and beneficiary/ local people.This system was practiced for the management of irrigation water for local people of this district. Where, system operated under the local rules, from among the member of irrigators, Waterman was employed for the distribution of water in rotation basis among the irrigator and the payment of water man was made by providing 30 bags of rice per annum and other goods in varying quantity,also the irrigator households were provided with the water rights certificate by the Government. The whole system of water management was operated by the beneficiary themselves, government intervention was found only at the time of the major dispute.

Chopra and Kadekodi (1990) studied the functioning of Sukhomajri (a Gujjar village in the Himalaya), where the government initiated lake restoration programme in 1980 by involving the community in watershed management. Under this experiment, common property resource was transferred to village society, and the water user cooperative society managed and distributed water on equal rights basis, with the active participation of beneficiaries. Dams for water storage and irrigation

were constructed and equal rights and equal shares of water were given to each household with the option to sell the surplus. It is stated that this community-based management regenerated the degraded hills and made village self-sufficient in food grains, milk and fodder. It is suggested here that establishing effective non-governmental, non-market institution is the real solution to the problem of commons.(cited in Mishra et.al 2008.TERI Press).

Datta and Virgo (1998) has reviewed the integrated Doon valley watershed management project and found that the project became successful to generate the income of people on one hand and to conserve the water, soil and forest resource on the other hand in the valley.

Nemarund and Kozanayi (2003) have investigated institutional arrangements that influence the use and management of water resource in Micro Catchment in southern Zimbabwe. It was found that both the private owned and government-owned water source were functioning under certain rules and regulation and was well followed by the local communities in mutual cooperation, though it was not in written form. Further, there were less conflicts over the use of water despite the lack of written rules for water access and distribution. Hence, it is argued here that unwritten rules are a part of the social fabric and can play an important role in determining access to natural resources such as water.

Jyotishi and Rout (2005) examined the Baliraja water institution and self initiated Sugar cooperative water sharing institution in Deccan Region to know, how far these institutions were successful in maintaining the equality of access to water and sustainability of productivity in village, maintaining equality in water access. The sustainability of productivity in village was the main objective of the water institutions but the field reality reflected that the former institution failed to provide

equal access of water among the villagers and also the farmers were allowed to irrigate only three acres of land with the limitation of growing only water intensive crops, which failed to recognise the market driven and profit driven approach. Whereas the latter water institution was successful to bring the equal water right without any restriction on crops choice and unequal landholding.

Kumar (2006) highlighted on the combine efforts of the local community along with the Panchayat to initiate the micro planning in water management in Madhya Pradesh. It has mentioned that micro-planning was initiated with the motive of improving the traditional drinking water source and rejuvenating the of dry hand pumps and was successful in managing water to the villagers. The cost of maintenance was burdened cooperatively i.e. 49% of the total cost funded by the Panchayat, 26% by the local community and 25 % by the external agencies.

Menon, Singh, Shah, Lee, Paranjape and Joy (2007) highlighted the work of Tarun Bharat Sangh in Rajasthan for the rejuvenation of traditional heritage of water harvesting system through community participation. This study shows that Lingmuteychhu watershed initiatives has played a significant role in influencing the direction of decentralization within the state and it has promoted community-based resource management, Further, the experiment helps to improve the livelihoods of people.

Transfer of water from the far distance source through pipeline could put a negative impact on the ecology and local sources, for instance, Hirway (2008) has assumed that the long distance pipeline for transferring drinking water can fulfil the local demands as well as will bring equality in the distribution of water. Their study highlighted the Narmada Pipeline for Drinking water supply for more than 9,833 villages and 135 towns in Gujarat. But the field observation and finding of the study

revealed that this project had not been able to ensure adequate water supply in a regular manner, also the local water source had been neglected by the people because of Narbada Project. The village water committee (Pani Samiti) which was functioning under the project for the maintenance of project also constitutes less number of women members, in some village, there were no women members whereas it is mostly constituted of more than three women members. This study suggests that it is essentials to treat and maintain local source as the main source for water supply and the transfer of water from distance source should be used in the dry season.

Toori (2009) tried to evaluate Gram Sabha in the Tanagar Block Rajasthan to find out the answer of whether community – based organization is a viable solution for the management of common property. The local people of Tanagar Block conducted Gram Sabha every time before the implementation of any project and schemes in the village. In the Gram Sabbha opportunities were given to all the members to express their opinion and suggestion. At the time of drought the villagers with the support of Tarun Bharat Sangh (TBS) built a number of water structure in the village to cope-up with the situation and also became successful to provide water supply to the village. The study concluded that the common property resource such as water, land and forest can be best managed through community participation.

The Case study of Pimpalanare village of Maharashtra reveals that self-developed model for water management through irrigation tank not only help to fulfil the household water need but also helped to grow more crops, has improved the living condition of the people (Mishra 2009).

The Study conducted by Mishra and Rai (2013) on the use of indigenous soil and water conservation practice among farmer in Sikkim Himalaya, has described indigenous soil and water conservation practice by the people of the watershed of

Sikkim Himalaya. The analysis was based on the information collected through a questionnaire survey, field observation and focus group discussion conducted in 2009-10 at Pabung Bankhola watershed, South Sikkim. Descriptive statistics were used, one-way analysis of variance was used to test the research expectations with SPSS software, and one way ANOVA analysis was applied to analyse the significant difference of indigenous soil and water conservation practice in a different watershed. In this study more emphasis has been given to the soil /land conservation than to water conservation.

II.6. Women and Water Resource Management:

Women are always close to the natural resource, they are responsible for collecting fodder, collecting grasses, fuel-wood collection and fetching water for domestic purpose but their this participation treated as invisible. Ruth (1998) argued that the trend of transfer irrigation management responsibility from the state to communities or local user groups has ignored the implication of intra-community power differences, gender differences for the effectiveness and equity of water management.

Women play a central part in the provision, management and safeguarding of water (Principle of Dublin- Rio 1992).The role of women in environmental protection in India can be traced back to 1731 AD when Amrita Rai sacrificed her life for saving the trees of her village.

Traditionally, women are responsible for resource mobilization and management. Fuel, fodder and water collections are the accepted responsibilities of women (Sharma and Kaushik 2011).

Aladuwaka and Momsen (2010) has highlighted the innovative women run water project of Wanaraniya Matale District of Sri Lanka, where women collectively

formed Vishaka Women society and had initiated the water project across the perennial stream of Bambara Kiri Ella, 6.5km away from the village to solve the water problem of the village, this women society successfully carried water through pipeline to every household of the village. These efforts of the women not only provided safe drinking water to the villagers but also helped in income generation. This study was an ethnographic research where data had been collected through interview, focus group discussion method.

Similarly, the study of Were, Swallow and Roy (2006) have found in western Kenya that women had formed women group for the management of water project when they felt marginalized in the water project. They raised funds by engaging as labour in harvesting and weeding. Money obtained was invested in planting tea seedlings which were later sold. Some amount of earning they distributed amongst the member and rest of the amount each member contributed for repaying of loan which was obtained by men for the construction of reservoir tank. Similarly, in another village in same district women's groups contributed from the monthly earning of Rs 500 towards the spring protection and purchase of pipes.

II.6.i. Indian Context

Prakesh and Sama (2006) has brought into the light, how social structure responsible for the increase in water scarcity in Vadali village in Gujarat where higher caste (Ahirs) people were getting water even in dry season whereas lower caste people were not getting enough water in rainy season. Women from Dalit, Kolis landless family are more vulnerable during the dry season because they have to depend on the high caste people. The village was dominated socially and economically by this caste. Upper caste people were more benefited by Scheme and project as compared to lower caste. Hence, it is argued that community-based

programme can remove corruption, but cannot change social structure with the short span of project time.

Joshi (2011) has focused on the interaction of caste, gender disparities across the household to the policy-making forum. Through field observation in Kumaun region, she found that gender disparity in water access is high. Especially the Dalit women were restricted to access the water from the source of high caste.

Khandelwal (2012) studied the involvement of women in natural resource conservation in Udaipur district of Rajasthan, through a random sample of 200 respondent from four villages, data for the study were collected through interview schedule, and were analysed and presented in the form of a frequency, percentage, rank.MPS "Z" test has also applied to see the difference between tribal women and non-tribal women with regards to involvement in water management. This study found that involvement of tribal women in planning stage was very low. It is argued here that quota of women's representative is essential to promote the involvement of women in conservational activities.

Satya and Cronin (2013) argue that there should be a change in the existing understanding of women work to make a change in respect to women representation in the water sector. Some suggestion which had been put forwarded in this study to increase women presence in the water sector are gender policy for water bureaucracy, gender-specific benefits and amenities, women-specific training etc.

Kulkarni (2013) argued that less research has been done in the women professionals in water bureaucracy, the main objective of her study was to understand the participation of women in water professional in South Asia, and it was found that a number of women participation in technical work was very less in India.

Thapa (year not mention) has put stress on the gender issue in respect to water collection, use and management, role in policy decision making relating to making provisions for water in Sikkim and has generalized this to the mountainous state as a whole. This study revealed that there was no gender difference in the matter of water collection in her study area, also formal bodies for water management does not exist, the representative for the issue related to water was only made by the male. Her study was based on the Qualitative analyses where datas were collected through the unstructured questioner, group discussion and field observation. It has been suggested here that policy implementation should take into consideration women as well as children in the issues related to accessing water.

II.7. Studies in the context of Sikkim

Drawing on empirical evidences from Sikkim, there are few studies, (Barua, Katyaini and Mili (2012), Tambe (2011),Tambe and Arrawatia (2012) that focuses primarily on the impact of climate change on water resource, biodiversity and overall on livelihood of the people and the people's perception on climate change, rejuvenation of drying springs, spring discharge. These studies have not analyzed two things: how communities are managing their water resource, and about community participation in water resource management for drinking purpose in dry parts of Sikkim.

II.8. Summary of Literature

In the present study, the literature on water resource management has been organized under different sub-themes namely, approaches in water resource management, right to water or water as an economic goods, social issues on water resource management, community participation in water resource management,

institutional practices for water resource management and women and water resource management.

Different approaches have been followed for the water resource management in different time period, such as, in the year 1950 60s emphasis was given to technology for proper water supply and management, in the year 1970 – 80 focus was on the state owned water infrastructure development and had ignored the traditional knowledge of water management. In the year 1980 emphasis was on treating water as economic goods. While in the early 1990's importance has been given to the participation of water user community or participatory approach in water resource management project. Thereafter participatory approach in both the domestic and irrigation water management system adopted worldwide.

The reason for the shift in the approaches to water management was that the approaches prior to the community participation were not able to bring solution to the water resource management. Further, the lack of maintenance and ownership of the water infrastructure developed by the government and other agencies was seen everywhere. It was realized after 90s that for the better management of water resource the involvement of the farmer and water users in decision making and planning process of water project is essential. Furthermore, decentralization of power to the water user to control the water infrastructure was also felt essential. So after 1990 government started involving the communities and rendering the responsibility of maintenance of water projects to the water users.

The positive consequence of community participation approaches in water management was observed in many water projects. This approach of water management could bring the sustainability of water projects, empowered the water user and increased the living standard of people as well. There are many success

stories of community participation in water management such as Pani Panchayat Scheme initiated in Maharashtra, Gram Gourav Pratisthan of Mumbai, Shwarjaldhara project, Weir system North Thailand, Community-based irrigation system in Bali Indonesia.

The number of studies on right to water argues that the access to water should be considered as basic human right. It is further mentioned that when the water is used for the irrigation and industrial purposes it should be treated as economic good and should charge for the use. Further, it has been mentioned that in order to reflect the usage value of water and to make the benefits of water sharing equal to all communities, water right/conservation credit should be transferable or rentable same as carbon trade. Some of the studies have explored the social issues on water resource management and community participation such as inequalities in access to water in terms of gender, caste and power relations. Some studies have made the argument that the government implemented project cannot always bring the social equality in water accessibility and equal distribution of water. Sometimes it fails to bring social equality (in terms of gender and caste and power relation) in accessing water for both the domestic and irrigation purposes. Further, the concept of community participation in water resource management has overlooked the level of participation of the disadvantaged communities.

The studies on community participation in water resource management have argued that the participation of water user communities or local people is essential to bring the efficiency in water resource management and to maintain the sustainability of water project. Most of the literature on community participation in water resource management has highlighted the success stories of local community headed water management system and community participation in government funded and other

external supported (NGOs) project for drinking and irrigation water management in different parts of the world in general and in India particularly. These studies have mentioned that collective action of the local community has not only been able to supply water to a village but has improved the economic condition of the villagers too. The studies argued that community can manage water resource in a better way than the institutions alone, government-funded water management project can only be successful when it involves the local communities.

Some other literature argues that community alone cannot manage water resource without the support of external agencies or funded agencies. The unwritten, flexible and local rules framed by the local communities can operate the water management system appropriately than the fixed or rigid government rules. Further, it has argued that studies of community participation have neglected the importance of geographical location and nature of water resource management.

The related literature on women and water resource management has emphasized on the role of women in natural resource management in general and water management in particular. The studies argued that the role of women has been overlooked or neglected in resource management. Further, their participation in water resource management organisation and committees is found less / low. Likewise, women are not getting equal access to water, especially the Dalit women. Aladuwaka and Monsen (2010) highlighted the innovative work of women as evidence that women can manage the water resource and can supply it to the village.

II.9. Research Gap

The available literature on water resource management and community participation has mainly focused on the participation of the community especially in irrigation water management in different parts of India. The related study from

Sikkim has stressed only on the different strategies adopted by the government to cope up with the impact of climate change. They have not paid attention to community participation in water resource management and have not highlighted on the ways by which money was generated to manage their water resource. Hence to extend the debate on community participation in water management, the present study will mainly focus on community participation in drinking water management and also will bring into light community effort in the management of water for drinking purpose in the drier parts of Sikkim.

CHAPTER - III

Physical, Demographic and Socio-Economic Chatracteristics

Socio-economic characteristics of an area reflect the livelihood of the people and their economic and social status. Study of socio-economic characteristic provides a general understanding of the economic standard of people along with their social structure and cultural setting. It also gives scope to know about how the livelihoods of people are changing and what may be the factors for such change. Before discussing the demographic and economic characteristics of rural areas of Namchi we have given the brief description of physical aspects (location, elevation and slope, geology and climate) of Namchi block in the paragraph below.

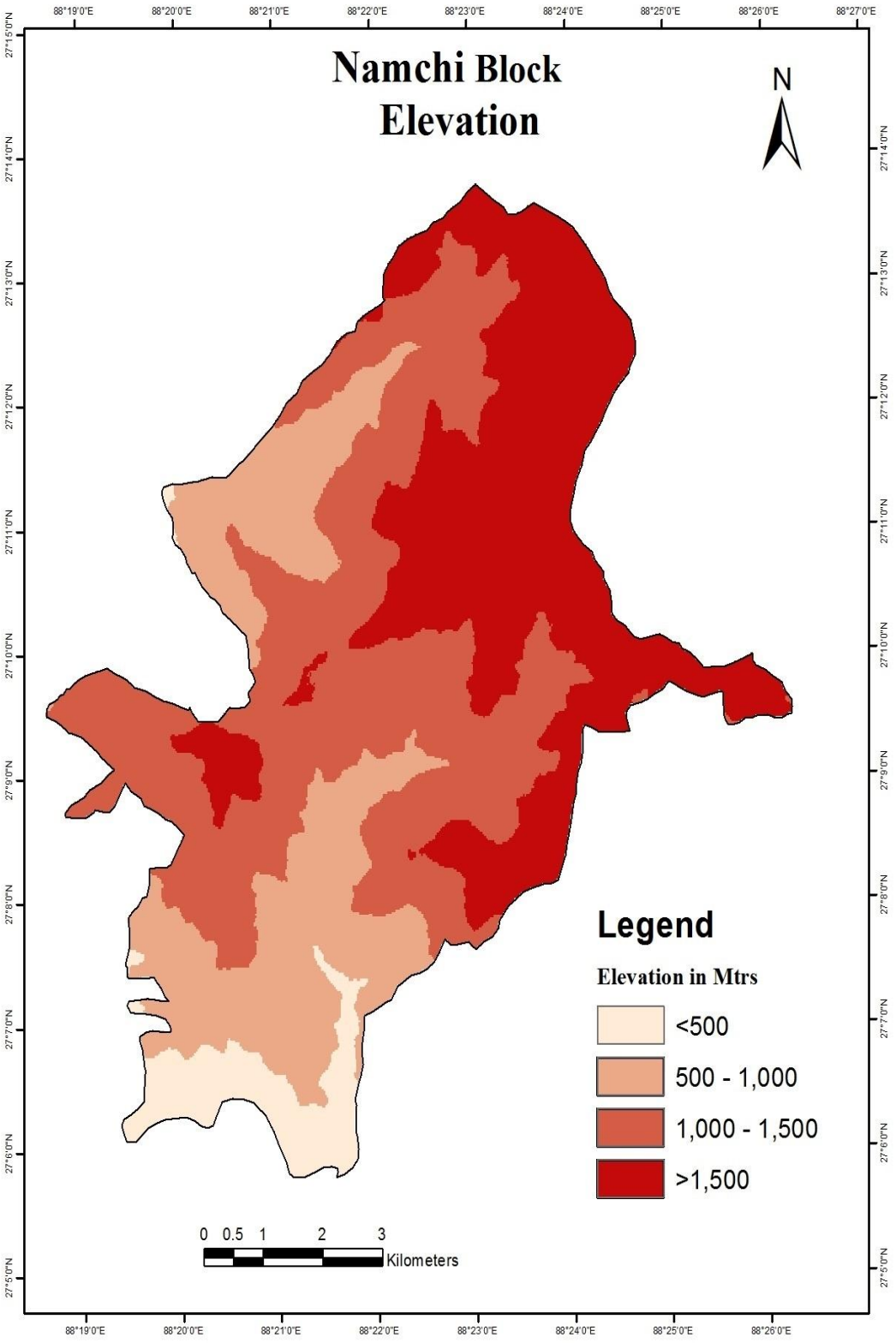
III.1. Physical Aspect of Namchi

Introduction

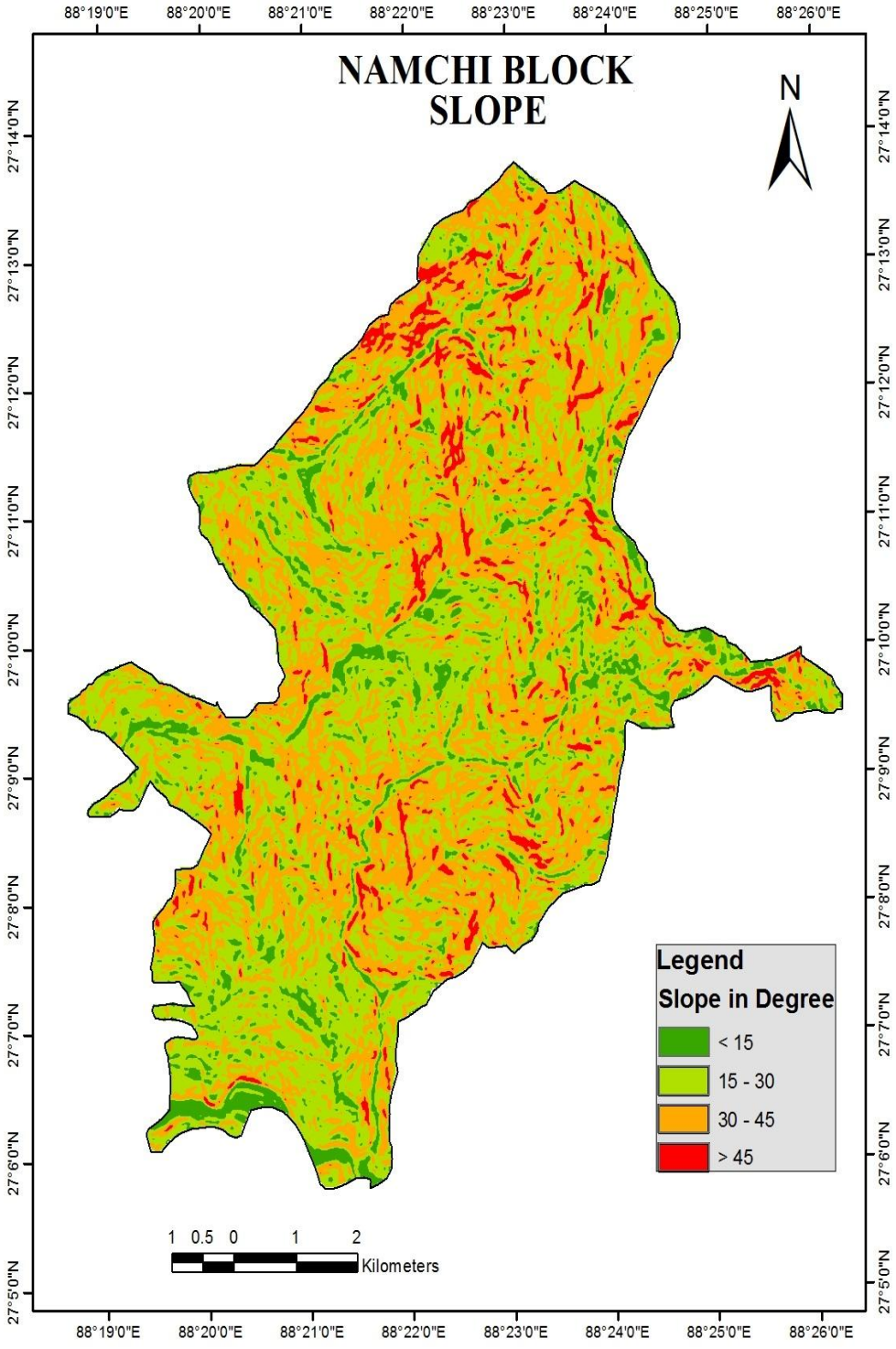
Namchi is district headquarter of South District of Sikkim and one of the sub-divisions of South Sikkim as well. Geographically it is located between 27°.10' N to 27° 17'N latitude and 88° 21'E to 88° 35' E longitude. Namchi covers the total geographical area of 552.93 squares kilometre of South Sikkim which constitutes 73.72 percent of the total land area of South District. In Namchi rural areas covers 545.33 Square kilometre and urban area covers only 7.60 Square kilometres which accounts 98.62 percent and 1.37 percent respectively to the total area of Namchi.

The Rural area of Namchi comprises of nine Gram Panchayat Units (GPU) while urban area is under Municipal Council (NMC) which consists of seven municipal wards. Namchi is the growing tourism hub of Sikkim. In the rural areas village tourism is becoming the source of livelihood of people and in the urban area, tourism has been substituting the economy of people. Namchi town is a fast growing

town of Sikkim in terms of population where decadal population growth rate is very high. It is inhabited by different ethnic and social groups. The rural economy depends on the agriculture and government sector while urban is mostly in government sector and business. Dry farming is commonly practiced in rural Namchi where the important crops grown in the village are maize, pulses, vegetables, ginger, chilly etc.



Source: Prepared by Author, adapted from DEM (ASTER), USGS, (ASTER, DEM is the product of NASA and MEITI)



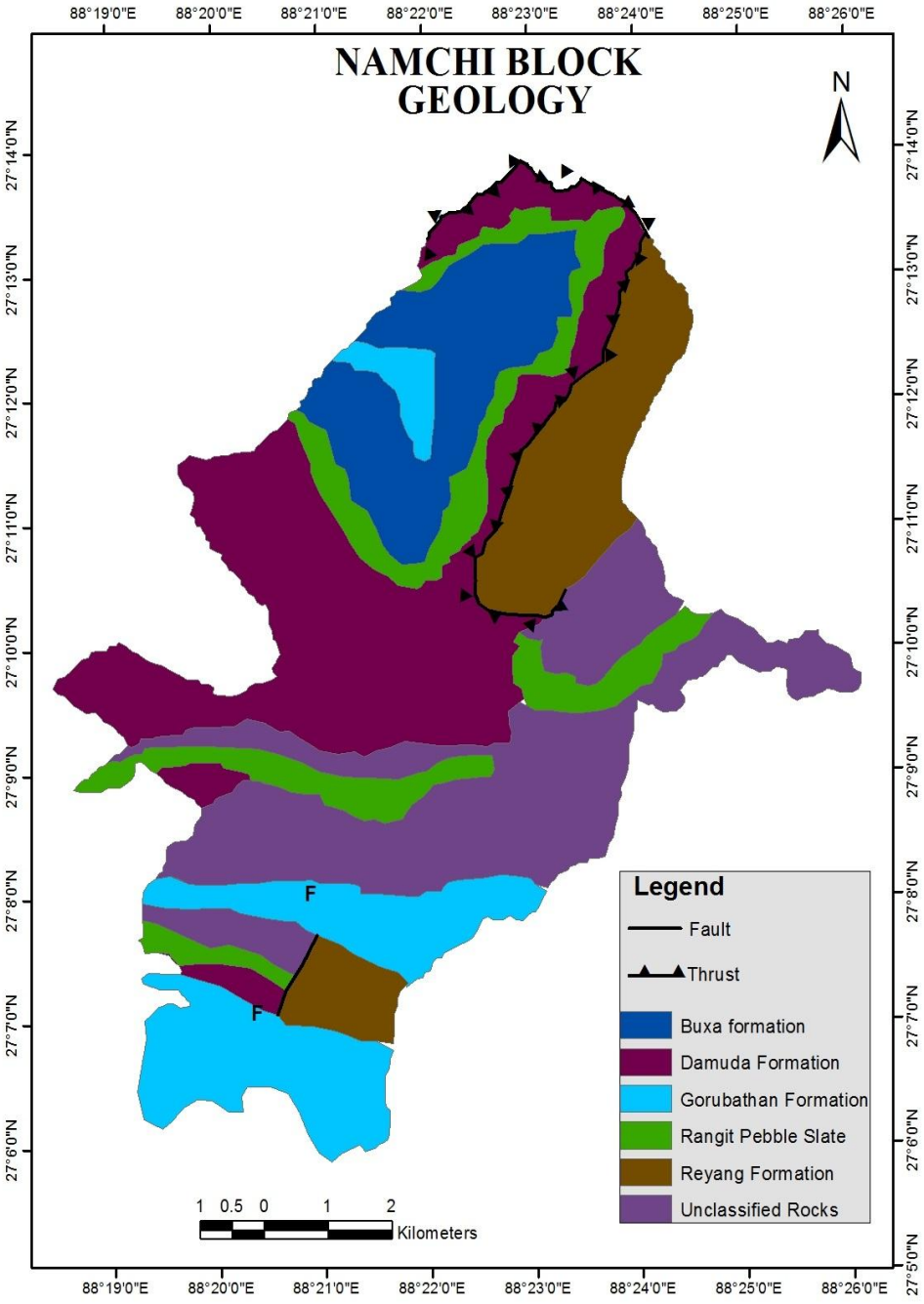
Source: Prepared by Author, adapted from DEM (ASTER), USGS, (ASTER, DEM is the product of NASA and MEITI)

III.1.i. Elevation and Slope

Generally, elevations affect the rainfall, as the moisture-laden wind while ascending up cannot reach high elevation with the same amount of water contained on it. While ascending up it loses most of its moisture in the form of precipitation in low elevation area and hence the low lying area witness high rainfall as compared to the highly elevated area. Similarly, a slope of the ground is one of the important factors determining the availability of water. The areas having a high degree of slopes encourage high runoff and cannot permit the water to penetrate in the subsurface. This may cause low recharge of aquifer followed by low discharge of springs as compared to the area with a lower slope. The elevation of Namchi varies from 193 meters to 2643 meters from mean sea level (MSL). An average elevation is 1,315 meters (4,314 ft). Generally, elevation increase from the southern part of Namchi towards North. However, in North Western part in - between the highest elevation areas, some low lying area is also present. The northern and eastern parts of Namchi have a very high elevation of more than 1500 meters from MSL. The low lying area with the elevation of less than 500 meters lies in the southern part of Namchi which is along the river Rangeet. The maximum part of Namchi is characterised by high elevation of 1500 – 2643 meters from MSL. The above map clearly illustrates that, from the northern part of Namchi, elevation decrease towards west and south. The area is characterized by a steep slope and rugged topography where a degree of slope varies from below 15 degree to 70 degree. The Northern part has steep slope than in the southern part of Namchi. The slope is gentle downward from the north towards south.

Along with the altitudinal variation, a micro level variation in vegetation pattern can be observed from Majitar, Kitam the southernmost part of Namchi to

Sholophok hill in the north. It has climatic zone range from Sub Tropical to Sub Alpine



Source: GOI (Modified after Neogi et. al 2000, GSI 2001, Catlos et.al 2002, 2004), Geological Department of Sikkim.

III.1.ii. Geology

The geological structure of a particular area or the underlying rock formation controls the underground water availability. The properties and characteristic of underplaying rock formation determines the aquifer condition which further determines the nature of spring discharge, especially in the mountainous area. Similarly, the presence of fault, fractures and crack affects the underground water and spring condition. There is a common belief that due to the presence of more fault and fracture the volume of discharge of water from the spring is decreasing considerably especially in the mountainous regions. Hence it is essential to know the geological formation of the area and rock types.

The geological formation of South Sikkim as a whole comprises Quaternary deposits of Gorubathan Formation. Along the rivers and streams alluvial deposits are found. Geologically, Namchi comprises of Gondwana and Daling groups of rocks formation, where a number of fault line and joints had occurred. Central and north-western part of Namchi comprises of different rock formation, viz Damuda, Rangit Pabbles slate, Buxa and Gorubathan formation. In these formation the abundant rocks types are Sandstone, Slate, Carbonaceous, Pabble, Boulder Slate, Conglomerate, Phyllite, Dolostone, Orthoquartzite, Purple Phyllite/ Slate and Chert.

The north-eastern part of Namchi composes of Reyang formation. There is a presence of thrust as a boundary line between the Damuda and the Reyang formation and extended up to the northwest part of Namchi. The presence of unclassified rock is in the western part while southern part of Namchi along the river Rangeet composes of Gorubathan formation where the Pyritiferous black Slate, Variegated Cherty, Phyllite and Metagraywacke are found. One fault line is occurred in the southern part of Namchi. The presence of long extended thrust and a fault indicates that the area is

geologically unstable and sensible to endogenetic forces. Such area may cause the subduction of water level and springs. Overall geologically the area is very complex which signifies there is no large and confined aquifer to give birth to large and perennial spring.

III.1.iii. Climate

The climate of Namchi is warm and temperate. The summer witnesses good rainfall, while the winter records very little rainfall or no rainfall. A decade of study of the rainfall pattern of the Namchi reveals that the area recorded very less rainfall from the month of November to April and no rainfall especially in the month of December and January which has made the area dry particularly during this period. The average temperature of the Namchi is 17.5° C. Most of the precipitation here falls in July month, on an average 740mm.

III.2. Demographic Characteristics

The demographic characteristic means the population composition of an area. To study the resource availability, distribution and management of a particular area, it is essential to know about the population characteristic of that area. Namchi shares 67.3 percent of population of the South district. There is decadal increase in the population. The sex ratio of the area is low in both the census year. A majority of population are in the age group of 18-59.

Table 3.1: Population of Namchi, 2001 -2011

Total/ Rural/Urban	Households		Population	
	2001	2011	2001	2011
Total (Namchi)	17081	20897	87350	98895
Rural	16330	16057	83404	77696
Urban	751	4840	3946	21199

Source**:** Census of India 2001, 2011

The population data of Namchi block from 2001 to 2011 reveals that the total population of Namchi increased with the growth rate of 1.32 percent in 2011. The rural area experienced negative growth rate of population i.e. (-0.68) in 2011. On the other hand population of urban area has increased in alarming rate with the population growth rate of 43.7 percent.

Table 3.2: Population of Villages, 1991-2011

Village	Total HHs			Population		
	1991	2001	2011	1991	2001	2011
Kitam	126	165	213	794	965	1036
Rong	89	99	139	445	499	589
Phalidara	108	141	171	623	811	808
Singithang	513	1303	74	2456	5749	338
Sorok	69	80	103	344	409	474

Source: Census of India 1991, 2001, 2011.

The data on number of households and population of the sample villages from 1991 to 2011 reveals that the number of households in Kitam, Rong, Phalidara and Sorok villages has increased. Similarly, in Singithang number of households almost increases by three fold from 1991 to 2001 but in 2011 it decreased 17 times to the preceding decade i.e. from 1303 to 74 households. Such decreased in the number households is due to the delimitation system of the government. In 2011 the boundary of the urban area of Namchi extended because of which those areas which fall in rural in 2001 are now in urban area. Hence, such abnormal change in the number of households came into the picture. Similarly, the total population of Kitam, Rong and Sorok village has increased from 1991 to 2001. Whereas in Phalidara population increased from 1991 to 2001 but in 2011 it decreased slightly. Likewise, in Singithang village population doubled from 1991-2001 but in 2011 the village experienced 17

times decreased in population as compared to preceding decade. This is again due to the boundary extension of the urban area. The village Singithang shares the boundary with urban area so the area which was earlier a part of Singithang now comes urban area. The consequences of which, was such that the population of Singithang village decreased and the population of urban area increased. The above discussion was all about the analysis of Census data while the following paragraph contains the analysis, interpretation and discussion of data collected from the field.

Table 3.3: Population of Surveyed Villages (Field Data)

Sample Village	Total HH	Total Population	Male	Female	Sex ratio
Rong	33	153	81	72	889
Upper Kitam	38	204	82	122	1488
Upper Sorok	30	136	71	65	915
Lower Phalidara	39	202	99	103	1040
Singithang	40	198	102	96	941
Total	180	893	435	458	1052

Source: Field Survey, 2015 – 2016 *HH- Households

The data on population collected from the field survey demonstrate that Upper Kitam has highest population followed by Lower Phalidara. On the other hand Upper Sorok has lowest population size. In Upper Kitam proportion of female population is higher than male. Likewise, in Lower Phalidara also female populations outnumber the male population. Whereas in Rong, the male population is higher than female, hence the sex ratio of this village is very low. If we compare the sex ratio amongst village, the sex ratio of Upper Kitam is very high, which is higher than nation level.

Out of the total population of the surveyed villages 48.7 percent are male and 51 percent are female. The overall sex ratio of the rural area of Namchi is high i.e. 1052 female per 1000 male.

Table 3.4: Distribution of Population of Surveyed Villages by Age Structure

Village	Age Group	No. Person	Male	Female
Rong	0-14	23	13	10
	15 -59	113	56	57
	Above 60	17	12	5
Upper Kitam	0-14	43	12	31
	15 -59	140	60	80
	Above 60	21	10	11
Upper Sorok	0-14	23	14	9
	15 -59	96	48	48
	Above 60	17	09	08
Lower Phalidara	0-14	44	19	25
	15 -59	142	71	71
	Above 60	16	09	07
Singithang	0-14	23	12	11
	15 -59	152	76	76
	Above 60	23	14	09
Total	0-14	156	70	86
	15 – 59	643	311	332
	Above 60	94	54	40

Source: Field Survey, 2015 - 2016

Table 3.4 of population at different age group reflects that the population between the age group of 0-14 is equal in three sample village viz, Rong, Upper Sorok and Singithang. Likewise, in Upper Kitam and Lower Phalidara population in 0 -14 is equal. The population in the age group of 15 – 59 is highest in all the sample villages as compared to the population in other age group. It is very interesting to know that in Upper Sorok, Lower Phalidara and in Singithang, the number of male and female population in the age 15 -59 is equal. The population at the age group of above 60 years is highest in Singithang followed by Upper Kitam. In majority of village dependent population is low and working age group population.

Table 3.5: Literacy Rate of Sample Village

Name of the sample village	Literacy rate	Male	Female
Rong	69.12	92.59	91.66
Upper Kitam	81.86	82.92	81.14
Upper Sorok	75.00	77.46	72.30
Lower Phalidara	77.72	83.83	71.84
Singithang	84.85	85.29	84.37
Total	82.3	85.12	80.41

Source: Field Survey, 2015- 2016

The data on literacy rate of sample village indicates that the overall literacy rate of the five sample village is 82.3 in which male literacy rate is 85.12 and female 80.4. Amongst the sample villages Singithang has a highest literacy rate followed by Upper Kitam. On the other hand Rong village has lowest literacy rate. The literacy rate of Upper Sorok and Lower Phalidara is almost equal. It is clear from the analyses that the majority of the rural populations are literate. There is not much variation in male- female literacy rate in almost all sample villages except in Lower Phalidara. The overall literacy rate of five sample village is equal to the state literacy rate.

Table 3.6: Distribution of Population by Level of Education (in percentage)

Level of Education	Total	Male	Female
Illiterate	17.7	15.8	20.0
Literate	1.9	2.29	2.0
Primary (1 –V)	22.5	23.44	23.0
Upper Primary	20.8	21.37	20.0
Matriculation	14.1	14.48	14.0
Higher secondary	11.5	11.72	11.0
Graduation	7.4	7.35	7.0
Post Graduation	2.7	2.06	2.0
Others	1.3	1.83	0.9
Total	893	435	458

Source: Field Survey, 2015 - 2016

Education is an important determinant for the study of the socio-economic aspect of the people. It is a medium to lead the society towards the different aspects of

development. [1]The education level refers to the highest educational level attained by a person. The above analysis shows that majority of population of the study area have acquired less education (i.e. primary and junior high school), one-third of the population have secondary and senior secondary level education qualification. Only 10 percent of the population has education qualification of Graduation and above Graduation. Though the proportion of population in the higher study is low but there is a probability of increase in future, because rural parents are becoming more conscious day by day regarding the importance of education and also the access of university-level education in the state.

Further, the gender wise data reveals that more females are illiterate than male. However, it is very interesting to know that there is an equal number of male and female who have acquired primary to upper primary level education. It shows the clear picture of no gender discrimination in terms of acquiring education in the study area. Very less variation of 3 percent can be seen in term of percentage of female graduate than male. On the other hand the percentage of women who have completed post-graduation or university level education is about 40 percent higher than male. Such a variation may because most of the male persons after completing secondary and graduation level study have joint different defense forces services. The share of the male population in other courses is 50 percent higher than female. The Literacy rate of the sample population is 82.3 percent wherein male literacy rate is 85.12 percent and female 80.41 percent. The literacy rate of the study area is almost equal to

[1] The education level of people have been categories in nine level i.e. – illiterate (those who cannot read and write any language), Literate (those who can write and read but have not done schooling), Primary (I-V), Junior High School (VI – VIII), Secondary (IX – X), Senior Secondary (XI – XII), Graduation, above Graduation(M.A, M.sc, M.Com, M Phil, Ph.D, Post Doctorate) and others (those who have done Diploma courses and other medical related study).

state literacy rate. The high level of literacy in a society can bring a positive change in the society and lead the society towards development.

III.3. Socio- Economic Characteristics

Table 3.7: Marital Status of Sample Population in Rural Area

Marital Status	Percentage	Male Percentage	Female Percentage
Married	45.9	46.89	45.0
Unmarried	49.4	48.73	50.0
Widow	4.7	4.36	5.0
Total	893	435	458

Source: Field Survey, 2015- 2016

There is very less difference between the number of the married and unmarried person in the study area. The proportion of unmarried persons is 3.9 percent higher than married persons. There is almost equal proportion of male and female married and unmarried to the total. The widow is higher than the widower in the area.

Table 3.8: Distribution of Households by Religion

Religion	Number of Households	Percentage to the Total
Hindu	130	72.2
Buddhist	21	11.7
Christian	29	16.1
Total	180	100.0

Source: Field Survey, 2015 - 2016

There is only three major religion followed by the rural people i.e. Hindu, Buddhist and Christian. The above analysis reveals that almost three-fourth of households are Hindu, which is the highest among the other religious households in the study area. Christian stood second in position with 16.1 percent of households and the proportion of Buddhist households is lowest among other religious households. If

we see the state level religious group, Buddhist households stand second after Hindu households but in this surveyed area Christian households are higher than Buddhist.

Table 3.9: Distribution of Households by Social Group

Social Groups	Number of Households	Percentage
ST	33	18.3
SC	11	6.1
OBC	134	74.4
General	2	1.1
Total	180	100.0

Source: Field Survey, 2015 - 2016, *ST- Schedule Tribe, SC- Schedule Cast, OBC – Other Backward Class, Others- general

Population has been divided into different social groups on the basis of their level of economic standard and level of backwardness. The different social groups which exist are Schedule Cast (Which includes castes like Kami, Dorjee, Sunwar), Schedule Tribe (ST) includes Limbo, Bhutai, Lepcha, Tamang, Sharpa, Other Backward Class Central list (OBC) includes Bhujel, Gurung, Manger, Rai, Sunwar, Sanyasi, Thami, Jogi, Dewan and OBC of state list includes Bahun, Chettri and Newar, Other (general category, basically are the plains people originating from various parts of the country and residing in Sikkim). The data reveals that three -fourth of the surveyed household fall under Other Backward Classes category, less than one -fourth of households are Schedule tribe, and 6 percent are Schedule Cast. There are only two non Sikkimese households.

Population have been categorised on the basis of the calories of intake and level of property owned into two categories viz Below Poverty Line (BPL) and Above Poverty Line (APL). Amongst the respondent household 59 percent are BPL and 41 percent are APL.

Table 3.10: Distributions of Households by Family Structure

Family Structure	No. of HH	In Percentage
Joint Family	56	31.1
Nuclear family	124	68.9
Total	180	100.0

Source: Field Survey, 2015 -2016

In today's society, it is difficult to find people staying jointly because of decreasing moral value and materialistic mind. But in the rural Namchi still, 31 percent of the household are staying jointly or in joint family.

Types of House

The house types are categories into three types (pucca, semi–pucca and kutcha) on the basis of material used for building the house. The Pucca house is one those whose walls, floor and roof are made of pucca materials like cement, concrete, stone, burnt bricks, and corrugated iron sheet. A kutcha house is one whose wall, roof and floor are made of kutcha materials such as thatch, mud, low-quality timber, grass, plastic sheet and other kutcha materials. A structure or houses which build by using both pucca and kutcha materials is termed as semi – pucca. The study indicates that 32.4 percent households have pucca house and 44 percent have semi-pucca house. There is only 22 percent kutcha house. The reason for less number of kutcha houses is because Government of Sikkim has provided houses to BPL category people under different housing scheme like Indira Awaas Yojana (IAY) House, Rehabilitation of earthquake damage house, Model house etc.

Table 3.11: Distribution of Household by Ownership

House Owned	Number of Households	Percentage to the Total
Own house	150	83.3
Government Quarter	16	8.9

Both (Govt. Provided and Own)	5	2.8
Rented	9	5.0
Total	180	100.0

Source: Field Survey, 2015 -2016

Table 3.11 reveals that most of the households have their own house. On an average 83 percent, households have their own house. In the study area, people are also provided with houses from government department under different housing scheme like Model House, earthquake rehabilitation house, Indhira Gandhi Awas Yojana (IAY) house etc. Only 3 percent of households have both own house and government provided houses. Especially in Rong village, almost all the households are provided with the government model house under model village scheme but equally, it was not in use properly and kept as a storehouse or vacant.

Table 3.12: Home Stead

House Stead owned	Number of Households	Percentage to the Total
Own house stead	169	93.9
Other's house stead	11	6.1
Total	180	100.0

Source: Field Survey, 2015 - 2016

The data reflects that majority of households have their own home stead only 6 percent are staying in other's house stead. In Sikkim, government also provides 50 decimal lands for those who are landless but this category was not found in the surveyed villages.

Table 3.13: Distribution of Households by Source of Fuel for Cooking

Source of Fuels	Total No. of HHs	Percentage to the total	BPL	Percent	APL	Percent
Wood	38	21.1	29	27.0	9	12.4
LPG	56	31.1	17	16.0	39	53.4
Wood and LPG	86	47.8	61	57.0	25	34.2
Total	180		107		73	

Source: Field Survey, 2015 - 2016

The source of fuel used for the domestic purpose is changing day by day, earlier the firewood used to be the main source of cooking fuel for rural people. But these days firewood user households are replaced by Liquefied Petroleum Gas (LPG). Table 3.13 reveals that more than one –fourth of households are using LPG as a source of cooking fuel. Half of the households are using both LPG and firewood as a source of cooking fuel. If we see the BPL APL category, more than half of APL households are using LPG whereas around one – fourth of BPL households are using wood as a source of cooking. Here the percentage of BPL households using both wood and LPG is more. This is because the government has provided LPG connection to BPL households.

The surveyed villages were found with 100 percent electricity connection. In respects to the availability of sanitation facility, 98 percent of households have sanitation facility. Villagers in the study area were also provided with pucca toilet under Swacchha Bharat Abhiyan Scheme and 100 percent sanitation scheme.

Table 3.14: Households Assets

Items	Number of Households possess to the total HHs	Percent
Radio	15	8.3
Tape recorder	74	41.1
TV	154	85.6
Computer	30	16.7
Laptop	44	24.4

Two-wheeler	7	3.9
Four Wheeler	49	27.2
LPG	155	86.0
Micro wave	3	1.7
Refrigerator	65	36.1
Water Motor	2	1.1
Total HHs	180	

Source: Field Survey, 2015 - 2016

Households asset means the households possess the items having monetary value. It is also an important determinant for the study of economic standard of people. The above analysis shows that television which has become a common household article, almost all the rural household possess television (i.e. 86 percent). With the advent of television the importance of radio has decreased sharply even though 9 percent of households are still having radio. Around 25 percent of households are having laptop. Percentage of households having laptop is higher than the households possessing computer, is because the government have provided laptop to the class twelve and undergraduate students. In the vehicle category, 27 percent households owned four - wheeler. LPG is increasingly becoming an important source of cooking fuel even in the rural area, for the purpose of easy use and less time-consuming people prefer to use it. 86 percent of households are having LPG. More than half of the total households own refrigerator in the study area. The above data shows that living standard of rural people of Namchi is good. But the village like Upper Sorok (some SC and OBCs households), Upper Kitam (the households in the upper ridge) and upper part of Phalidara appears to have in the low standard of living.

Table 3.15: Land Holding Patterns

Land holding size class (in Hectare)	No. of Households	Percent
Landless	04	2.2
Marginal (< 1 ha)	141	78.4
Small (1 – 2 ha)	26	14.4
Medium (2 – 10 ha)	9	5.0
Total	180	

Source: Field Survey, 2015 -16

The size of landholding in surveyed area varies from marginal to medium. The above class/ category of landholding are based on the Agriculture Census of Sikkim, 2010 -11. The above data reveals that 78 percent of the total households have marginal land holding i.e. below 1 hectare. While 14 percent of households fall under the landholding of small size and very few households have medium size landholding. Overall, the majority of rural households have fragmented land holding, even some households do not have their own land and settled in a leased-in land.

Table 3.16: Land under Cultivation/ Cultivated Land

Cultivated land (in Hectare)	No. of Households	Percentage of Households
0	35	19.4
Marginal (< 1 ha)	138	76.7
Small (1 – 2 ha)	7	3.9
Total	180	

Source: Field Survey, 2015 - 2016

In the rural areas, majority of the people have used their land for cultivation, as the livelihoods of most of the people are agriculture. In the study area 19 percent households do not cultivate land and are generating their income from sources like government services, business, livestock and others source (includes contractor, wage labourer 'MGNREGA'). On an average 76 percent of the households have less than one hectare of land under cultivation. Likewise only few households are cultivating 1

to 2 hectare of land. If we see preceding Table 3.15 only four households are landless amongst the surveyed household but in Table 3.16, 35 households have not brought land under cultivation which means most of the lands are left fallow. It is observed during field survey that dry farming is practiced in all surveyed villages mainly due to the paucity of water.

Table 3.17: Crop Grow

Crop types	No. of Households	Percentage
Ginger, maize, pulses, chilly and vegetable	45	31.0
Ginger, pulses and vegetable	2	1.4
Maize, pulses, chilly and vegetable	28	19.3
Maize, chilly and vegetable	14	9.6
Orange, maize, pulses, chilly, vegetable	3	2.0
Chilly and vegetable	2	1.4
Pulses, chilly and vegetable	1	0.7
Only vegetable	8	5.5
Maize and vegetable	5	3.4
Ginger, maize, chilly and vegetable	21	14.5
Ginger, maize, pulses and vegetable	14	9.6
Cardamom, ginger and vegetable	2	1.4
Total	145	100.0

Source: Field Survey, 2015-2016

Amongst the total households 145 households cultivate land. The major crops grown are maize, cardamom, ginger, orange, chilly, vegetable of different types and pulses etc. Every household grow a combination of three to four crops. Table 3.17 reveals that 31 percent household grows ginger, maize, pulses, chilly and vegetable. Likewise, 19 percent grow maize, pulses, chilly and vegetable and 14 percent household grow ginger, chilly, maize and vegetable. The shares of horticulture crops growers are highest amongst the respondents compared to food crops and cash crops. Within horticulture, every respondent household grow vegetable. The second

important crop grown in the sample village is Maize, but mainly for self-consumption not for commercial purpose. Further, the third important crop grown in the village is ginger. Ginger is grown solely for commercial purpose. Ginger is one of the important cash crops which contribute much to the income of households. On an average villager produce 4 quintal – 6 quintal of ginger and sell it at the market price of Rs 2250 to Rs 3000 per quintal.

Furthermore, every household grow vegetable but the area is very less as compared to other crops and it is mainly grown for self-consumption. The study further demonstrates that amongst the horticulture crops chilly and pulses are grown by majority of respondent households for commercial purpose. Chilly growers produce 2 – 10 kg of chilly/ (fireball) locally called (*Dalla khorsani*) per week for four months and sell it at the market price of Rs 150 per kilogram. Pulses grower sell around 10 kilogram to 120 kilogram per year at the market price of Rs 150 per kilogram. Overall it is observed that in all the surveyed village rain feed crops are grown like maize, chilly, ginger and pulses.

Table 3.18: Distribution of Households by Monthly Income

Income category (in Rs)	No. of HHs	In percentage
< 2500	1	1.0
2501 – 5000	22	12.22
5001 – 10000	65	36.1
10001- 25000	38	21.1
25001 and Above	54	30.0
Total	**180**	**100.0**
Mean = 23668		
SD = 4129		

Source: Field Survey, 2015 – 2016

Level of income is an important determinant for the study of economic standard of people. The above data reveals that the majority of surveyed household

have a monthly income of Rs 5000 – 10000, followed by the income group of Rs 25001 and above. The household within the income group of Rs 10001 – 25000 accounts 21.1 percent. While the households within the income group of Rs 2501 – 5000 constitute less i.e. only 12.2 percent. The households having a monthly income of less than 2500 are insignificant. This analysis gives a clear picture that, the economic condition of the rural people of Namchi is good. The above mentioned income categories of households are based on the classification made by the socio-economic census 2006, Government of Sikkim.

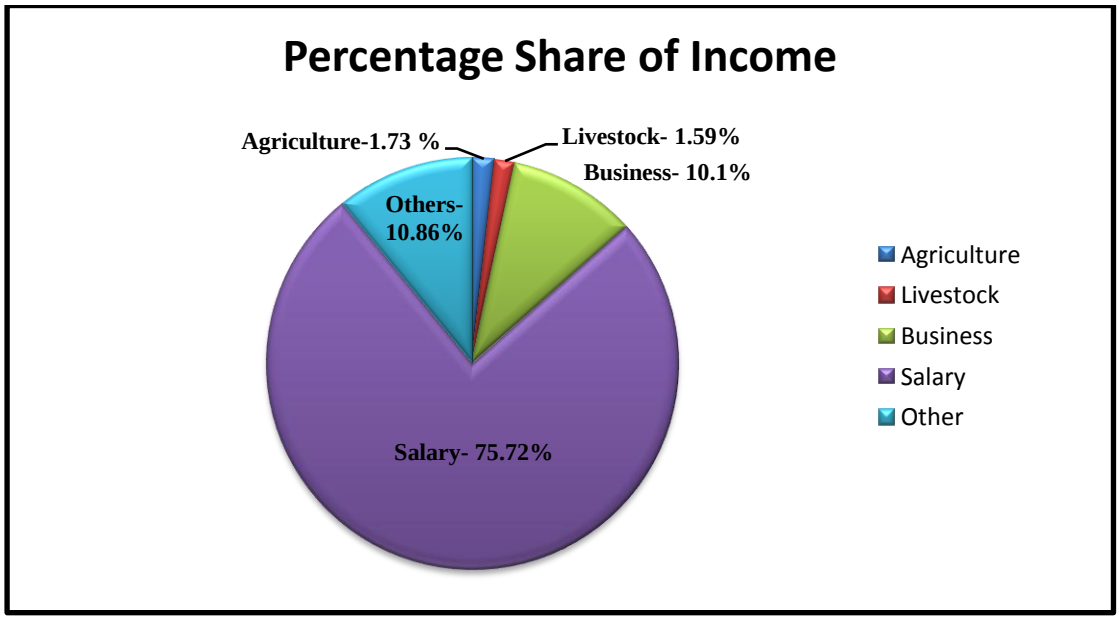


Figure: 3.1. Percentage share of different Income Sources

Source: Field Survey, 2015-2016

The monthly income of the household is calculated by summing the income generated from different sources like income from agriculture, livestock, salary, business and [2]others sources. The monthly average income of the rural households is substantially good. However, the standard deviation clearly shows that the there is a

[2] Other source here means income generated from contract work, wage from MGNREGA, and wage from house painting work.

very high range of income variation amongst the households. A data on the percentage share of the income exposed the surprising fact that the income from salary contributes around three – fourth of the monthly income of the households. Whereas the share of agriculture to the monthly income of households is very low i.e. only 1.7 percent, which is lowest amongst the share of major sources of income. Likewise, the income share of business and other sources is almost equal. The share of these two sources to the household income is higher than the agriculture.

Table 3.19: Distribution of Households by Expenditure Pattern

Expenditure Pattern of HHs (in Rs)	No. of HHs	In percentage
< 2500	4	2.2
2501 - 5000	53	29.5
5001 - 10000	64	35.6
10001- 25000	50	27.7
25001 and Above	9	5.0
Mean = 9855	-	-
SD = 2459	-	-
Total	**180**	**100.0**

Source: Field Survey, 2015-16

The pattern of monthly household expenditure shows that around 36 percent households have monthly expenses between of Rs 5001 – 10000. Similarly, 30 percent households are having a monthly expenditure of Rs 2501 – 5000 for different components. Similarly, household with monthly expenditure 10001 – 25000 constitutes 28 percent. Households having monthly expenditure of above 25001 are limited. The household in this category account only 9 percent.

Table 3.19.i: Average Monthly Household Expenditure in Different Components (in Rs)

Household Monthly Income	No. of HHs	Average expenditure	Food	Cloth	Health	Education	Rituals	Water	[3]Other
< 5000	58	3806	2058	407	187	216	361	17	560
5001-10000	65	7180	3189	760	373	1027	570	19	1242
10001-25000	49	15349	5275	1686	810	3992	999	47	2540
>25001	9	32855	6389	2620	635	16222	1719	48	5222

Source: Field Survey, 2015-2016

[3] Others- Expenditure on recharge of mobile, television and travel.

The monthly expenditure of households is calculated by summing the expenditure in different aspects like food, clothing, health, education, rituals, and others. Table 3.19.i. reveals that the monthly expenditure on food is highest in all income groups except income group of above 25000. Similarly, expenditure on education is second highest monthly expenditure share of income group of 10001-25000. The share of monthly expenditure on others is second highest expenditure sector for households having monthly income up to Rs 10000 while for the income group of 10001-25000 and above 25000, it is third highest expenditure share of monthly expenditure. The percentage share of monthly average expenditure on cloth is almost same in all income groups i.e. 8-10 percent. Likewise, the share of monthly average expenditure on rituals of income group of Rs. 10001-25000 and above Rs 25000 is less as compared to the households having monthly income up to Rs 10000. The monthly expenditure on health is low in all income groups as it shares only 3 to 6 percent of average expenditure. This indicates that the health condition of the respondent household is good. . There is no distinct expenditure pattern amongst the different income groups. For instance, the households having monthly income of above Rs. 25000 have highest expenditure on education followed by food and others. All the income group households are spending money on water but its share on monthly average expenditure is very low. Here, the expenditure on water only includes monthly water charges not the expenditure on water connection, and buying water storage facility.

Table 3.20: Distribution of Population by Sector of Economy

Occupation	No. of Population	Percent	Male	Percent	Female	Percent
Primary	194	41.7	111	38.2	83	47.7
Secondary	125	26.9	90	30.9	35	20.1
Tertiary	146	31.4	90	30.9	56	32.2
Total working population	**465**		**291**		**174**	100.0
Total population	**893**		**435**		**458**	

Source: Field Survey, 2015 - 2016

The livelihood of rural people is agriculture in rural Sikkim. The occupation pattern of the rural people varies from cultivator, agricultural labourer, wage labourer, carpenter, tailor, blacksmith, contractor, driver, business, peon, army, police, teacher, accountant, bank manager, engineer, doctor etc. Table 3.20 reflect that amongst the working population, the number of person engaged in primary activities are highest percent than in secondary and tertiary sectors. The share of working population in tertiary activities is 31 percent. Similarly, on an average 27 percent of the population are engaged in secondary sector. In all three sector of economy percentage of male population is higher than female. Amongst the male working population, 38 percent are engaged in primary activities and 30.9 percent are engaged in secondary and tertiary sector. Amongst the female working population, 47 percent are engaged in primary, 32 percent in tertiary and 20 percent are in secondary activities.

The above discussion shows that the proportion of working population in primary sector is high but a large number of populations are engaged in tertiary activities or service sector even in rural area. It is found during field survey that from almost every surveyed household especially in Upper Kitam and Singithang one to

three members are in Government job. Thus, the monthly income of the majority of the surveyed households comes from the salary which is reflected in (Table 3.18.i).

Table 3.21: Workforce Category of Villages, Census 2011

Name of the Village	Total Worker			Main worker					Marginal worker
	No. of Person	Male	Female	Total	Cultivator	Agricultural Labour	HHs Industry Worker	Other Worker	
Kitam	532	283 (53.0)	249 (47.0)	464 (87.2)	246 (53.0)	19 (4.0)	15 (3.2)	184 (74.8)	68 (12.8)
Rong	343	198 (57.7)	145 (42.3)	242 (70.6)	158 (65.3)	33 (20.8)	1 (0.4)	50 (20.7)	101 (29.4)
Upper Sorok	266	150 (56.3)	116 (43.6)	144 (54.1)	107 (74.3)	NA	NA	37 (25.7)	122 (45.86)
Lower Phalidara	419	240 (57.3)	179 (42.7)	98 (23.4)	05 (5.1)	NA	NA	93 (94.9)	321 (76.6)
Singithang	163	101 (62.0)	62 (38.0)	154 (94.5)	59 (38.3)	03 (1.9)	01 (0.6)	91 (59)	09 (5.5)

Source: District Census Handbook 2011, Census of India

Table 3.21 reflects the workforce category of the five villages of Namchi block. The data reveals that amongst these villages Kitam has a highest number of working population. The main worker constitutes 87.2 percent and marginal worker constitute 12.8. Further, within Kitam majority of them are cultivator followed by other worker. In all the villages main workers are higher than marginal worker except in Lower Phalidara. Similarly, in four village the main cultivator is higher in number than marginal cultivator. While in Lower Phalidara marginal cultivator is very high. Further, amongst the agricultural labour the main agriculture labour is high in Rong while marginal agricultural labour is in Lower Phalidara. Likewise, a large number of people engaged in other work are highest in Kitam followed by Lower Phalidara and Singithang.

Overall, the working population is highest than none working population in the four village but in Singithang non-working population is higher than working population. Further, within the working population male worker is higher than female worker in all the villages. Similarly, amongst the main worker male outnumber the female in all villages. While in Kitam and Rong female marginal worker is higher than male. Likewise, within marginal agricultural labour number of female is higher than male.

Table 3.22: Distribution of Population by Categories of Work

Occupation	No. of Population	Percent	Male	Percent	Female	Percent
Cultivator	145	31.2	89	30.6	56	32.1
Agricultural labourer	51	10.9	20	6.9	31	17.8
Trade and commerce	50	10.7	24	8.2	26	14.9
Manufacturing (Non household industries)	73	15.7	62	21.3	11	6. 3
Service sectors	146	31.5	96	33.0	50	28.7
Total working population	465	100.0	291	100.0	174	100.0
Total	**893**		**435**		**458**	

Source: Field Survey, 2015- 2016

The occupation pattern of the people has been further categorised into different work categories such as cultivator, agricultural labourer, trade and commerce, manufacturing, and service sector. Amongst the working population, proportion of cultivator and service sector workers is almost equal i.e. 31.2 and 31.5 respectively. Similarly, the proportion of agriculture labour and trade and commerce is equal. On the other hand the share of working population in non-household industries is 16 percent. Within the male working population 33 percent is in service sector, 30 percent is a cultivator and 21.3 percent in manufacturing. Likewise,

amongst the female 32.1 percent is a cultivator, 28.7 percent is in service sector, 17.8 percent is an agricultural labour and around 15 percent is in trade and commerce.

The above interpretation revealed that the service is becoming an important income source of rural household. Beside this, industries and trade and commerce are also emerging as important income source. The study further shows that the female agricultural labour is higher than male. This is because in MGNREGA most of the workers are female. In addition to this, most of the household male members are in service sector and hence female takes responsibility of agricultural work. Similarly, proportion of male in non-household industries is higher than female. Overall, the economy of rural households is shifting from agriculture to service, trade and commerce and industries sector.

III.4. Summary

Physically, Namchi is characterized by rugged topography with slope range from 15 degree to 75 degree. Elevation varies from 193 meters to 2643 meters from mean sea level (MSL). An average elevation is 1,315 meters (4,314 ft). Geologically Namchi is unstable because it comprises of two thrust and fault line.

A temporal analysis of population scenario in Namchi reflects that the population is increasing in every successive decade. The rural population of Namchi has decreased from 2001 -2011 while the urban population has increased very rapidly which is mainly due to the reorganization of boundaries and rural to urban migration. The sex ratio of both the rural and urban area is low. Similarly, the population data of villages from 1991 to 2011 shows that the Kitam Village is fast growing village in terms of population while the Sorok and Rong village experienced steadily growth of population. The population of Phalidara and Singithang Village decreases in 2011. The Singithang Village exist as the most populated village amongst the five villages in 1991 and 2001, while this became lowest populated village in 2011. Such abnormal

change in the population is due to the delimitation of urban area as this village shares boundary with the urban area. There is no similar trend of population growth in sub-district and village level. Likewise, the major demographic characteristic of surveyed village revealed that the Upper Kitam is highest populated village while Upper Sorok is lowest populated village. The sex ratio at sub-district level is low while it is high at village level. The Kitam, Sorok and Singithang village experienced high sex ratio in 2011. The overall sex ratio of all the surveyed villages is high. In all the sample villages population at age group of 15 -59 constitutes highest. Likewise, the literacy rate of the surveyed village is higher than state literacy rate. The male are more literate than female.

Three-fourth of the households is Hindu by religion followed by Christian and Buddhist. Similarly, near around 75 percent of the household is Other Backward Class (OBC). On an average three – fourth of the household have pucca and semi-pucca house. Number of kutcha houses is less because the Government of Sikkim has provided pucca house to BPL family under the scheme called Indira Awaas Yojana and Chief Minister Rural Housing Mission. It is worth noting that all the households are electrified and have good sanitation facilities. For some BPL household, Government have constructed pucca toilet under Swacchha Bharat Abhiyan Scheme. Similarly, most of the household use both LPG and Wood as domestic fuel. But the availability of basic element that is water is very limited. The details of which will be discussed in next section.

The economic condition of the household is good as most of the household possess high value assets like television, refrigerator, vehicle, computer and laptop etc. But village wise it varies as, many of the households in Upper Kitam , Upper Sorok and Rong village do not have such assets. Likewise, the monthly income of the

majority of the household ranges from Rupees 5000-10000 and above Rupees 25000. There is high variation of income amongst household as some of the household have monthly income less than rupees 5000 while others have above rupees one lakh. Even in the rural area salary is the major source of income followed by the business. The income from agriculture is very low. This shows that rural economy is changing from agriculture to service sector and business. Amongst the working people majority of them have engaged in primary sector, but the income share of this sector is very low. On the other hand people engage in tertiary sector is comparatively low but the income share of this sector to the monthly income of household is very high.

The land holding pattern of household reveals that almost all the household have land but majority of them have marginal holding. Further, amongst the landholders 80 percent are cultivating their land. The major crops grown in the villages are maize, ginger, pulses, vegetable and chilly. Every household practice mixed cropping; they grow a combination of different crops. Further, household grow only rain feed crops due to water less availability of water.

The above discussions demonstrate that the socio-economic background of the study area is good as around 89 percent of the household have pacca and semi- pucca house. Similarly, half of household have monthly income of above Rs.10,000 and Rs. 25000. Service sector is the major income source. In addition to this, the literacy rate of the rural area is equal to the state literacy rate. Overall the economy is changing from agriculture to service sector. Even in such type of socio-economic setting, availability of water is limited. So it is essential to know how the rural households are managing this limited resource to maintain their socio-economic condition. So in the next chapter we will discuss about water availability status, access and purpose of use at household level in the rural area.

CHAPTER IV

Availability, Access, Mode of Water Use and Management in Rural Areas of Namchi

This chapter presents the different form of water resource availability in Sikkim, South Sikkim and Namchi. The objectives of this chapter are to know about water availability in South Sikkim and Namchi, household level information on water availability: mode of access of water, types of connection, timing of water supply. Further, the chapter contains the household level water management practices such as availability of water storage facility, water collection practices and rainwater harvesting practices and purpose of water use.

IV.1. Water Resource in Sikkim

Water in Sikkim are available in the form of glaciers, lakes, rivers, streams, spring, underground water and rainfall. Glaciers are the most important source of water in Sikkim. The main rivers of Sikkim the Teesta and the Rangeet originates from the glaciers. In Sikkim, all the glaciers are confined to the northern and the western part of the state. The important glacier which feeds the river of Sikkim is presented in the table below.

Table 4.1: The Important Glaciers of Sikkim

Sl. No	Name of the Glacier	Location (District)
1	Zemu Glacier	North
2	Rothang Glacier	West (below Rothang peak)
3	Lonak Glacier	North
4	Hidden Glacier	North
5	Talung Glacier	North
6	North Lonak Glacier	North
7	South Lonak Glacier	North
8	Tista Khangse Glacier	North

Source: Sikkim Statistical Journal 2013, Department of Economics, Statistics, Monitoring and Evaluation (DESME), Government of Sikkim

These glaciers are a storehouse of water resource of the state and have given birth to large and a number of small rivers (Chu). The water stored in by total glacier and permanent snow cover area which falls under Teesta basin is estimated as 145.05 Cubic Kilometres (State of Environment Sikkim 2007, Chapter - III). The melted water of these glaciers accumulated in the form of lakes in high altitude form headwater for the rivers. Among these glaciers, Zemu is the largest glacier in the state which spreads over 2391sq km and has given birth to the main river Teesta. The Rathong glacier is second largest glacier of the state. It occupies an area of 2351.12 sq Km. This glacier gives rise to the Rothang Chu which contributes to the river Rangeet, an important tributary of the river Teesta. Lonak glacier gives rise to Lonak Chu, one of the important sub-tributary of the river Teesta. In Sikkim, lakes are confined to the high altitude above 5000 meters.

Lakes are not only the storehouse of water but also playing a great role in maintaining the stability of water ecology in the region. It also contributes indirectly to the revenue generation of the state through tourism. Natural lakes of Sikkim are worshipped by the people. Most of the lakes of Sikkim are of glacier origin. The high altitude lakes remain frozen in winter because of very low temperature and in summer it melts and feeds rivers and streams. The major lakes of Sikkim are listed in the table below.

Table 4.2: Major Lakes of Sikkim

Sl .No	Name of the Lakes	Location(District)
1	Changu (Tsongo)	East
2	Menmecho	East
3	Bidang Cho	East
4	Khe-Cheod-Palri (Khecheoperi)	West
5	Lam Pokhari	West
4	Laxmi Pokhari	West

5	Majur Pokhari	West
6	Dud Pokahri	West
7	Samiti Lake	West
8	Ram Laxman (Twin Lake)	West
9	Sima Choka	North
10	Cholamu	North
11	Gurudongmar	North

Source: Sikkim Statistical Report 2013 DESME, Government of Sikkim

IV.1.i. River System of Sikkim

Rivers and streams are the flowing water resources, which fulfil the needs and sustains the livelihood of the people residing all the way from its source to its mouth. Sikkim has only one major river system namely the Teesta river system, which falls as a subgroup under the Brahmaputra river system. Sikkim is drained by the main river Teesta and its tributaries. Rising from the north-eastern corner of the state from Tista Kangsa glacier and Cho Lamu Lake at the altitude of 5400 metres, river Teesta flows little North –West direction in the form of Chombo Chu, a small low volume river. From the Donkung it flows in south direction. The river Teesta is joined by a number of large and small tributaries from both left and the right bank which contributed a large volume of water to the river. The first tributary which joined the river Teesta from the west is Zemu Chu originated from Zemu glacier. The Zemu Chu receives the water from tributaries namely Lonak Chu and Thomphyak Chu and finally, it merges with the main river Teesta at Zema few kilometres North from Lachen.

South to Zemu Chu, Talung Chu joints the main river Teesta at Singhik Sentam. Talung chhu receives water from Rungiang Chhu, Rukelel chhu, and joint water of Umaram Chhu and Passamram chhu. Thereafter it flows in the name of

Reoung Chu for few kilometres, and then it is joined by Ringi Chu and Rang Chu. Finally it flows in the name of Talung Chu and joined the river Teesta. Further south in its journey, river Teesta is joined by the river Great Rangeet below Melli Bazar. The Rangeet River flows almost as a boundary line between the West and the South district of Sikkim. The River Rangeet is fed by some more tributaries namely, the Rothang Chu the chief feeder, originated from the Rothang glacier. Besides, it is fed by Kuum Chu, Relli Chu, Rambi Chu, Kalej Chu, Reshi Chu, Roathak Chu, Rammam/ Rangbang *Khola* and Manpur *Khola.* It is also joined by tributaries from the Darjeeling namely, the little Rangeet and Rangnu Khola.

Similarly, from the west the River Teesta receives a number of tributaries namely, Lhasa Chu, Burun Chu, Gey Chu, Tarum Chu, Rabom Chu. These are the small tributries while the Lachung Chu is the important left bank tributaries which is fed by Sebozung Chu and joined the main river Teesta at Chungthang. Further south the main river Teesta receives water from small tributaries like Raye Chu, Omg Chu, and Chakung Chu. Dik Chu another tributary which joins river Teesta at Dik Chu East Sikkim. The Dik Chu marks the boundary between the North and the East districts of Sikkim. The Rongni Chu (feeds by Tak Chu and Rognek Chu, Yili Chu) joins the main River at Singtam. The Rangpo Chu (the feeder of this river are Reshi Chu, Rongli Chu, Rangbang khola, Chuba Khola) is the last tributaries from the east which meets main river Teesta at Rangpo. From Rangpo, the Teesta River flows southward and meets the west tributaries the Great Rangeet near Melli Bazar the southernmost point of South Sikkim.

The Eastern tributaries of the Teesta River are larger in number than the western tributaries but in terms of length, the western tributaries are longer in length than the eastern tributaries. Further, the most of the western tributaries are originated

from the glaciers hence they are larger in volume. The width of river Teesta varies; it is 30 meters at Chungthang and 40 metres at Singtam and the average depth of the water is 1.8 meters and 4.5 meters respectively. The velocity also varies from hill to Terai, in the former the velocity is high as 6 meters per second and in the Terai, the velocity is 2.4 to 3 metres per second. The volume of rivers increases in the monsoon season due to high rainfall while it decreases in the winter season. After travelling the distance of 151 km within the state through a deep valley and gorges the river Teesta enters the plain of West Bengal at Sevoke near Siliguri. The total length of the river Teesta from its source to the mouth is 414 km. The total catchment area of the river Teesta in Sikkim is 6,930 Sq. Km. Besides providing the water resource to the states, the rivers of Sikkim also has contributed to the economic growth of the state. As the voluminous rivers flow from the high gradient provides the suitable ground for the establishment of the hydro project. Hence, many hydro projects have been established on the perennial rivers of thousand megawatts. By selling this power to the neighboring state, the government of Sikkim is generating needed revenue for the state.

Table 4.3: The Major Tributaries of the River Teesta

Sl. No.	Left Bank Tributaries	Right Bank Tributaries
1	Lachung Chu	Zemu Chu
2	Chakung Chu	Rangyong Chu
3	Dik Chu	Ramgit Chu
4	Rani Khola	
5	Rangpo Chu	

Source: Topographical Map of Sikkim, Scale 1:1000000 and Choudhury Maitreyee, Sikkim Geographical Perspectives, 2006

Table 4.4: District Wise Distribution of Rivers in Sikkim

Sl. No.	East District	West District	North District	South District
1	Rate Chhu	Prek Chhu	Chhamba chhu	Kayam chhu
2	Bakcha Chhu	Chokchurang Chhu	Lasha Chhu	Rangit Chhu
3	Dik Chhu	Yangsa Chhu	Kalep Chhu	Lungdung Chhu
4	Bya Chhu	Dhap chhu	Gyamthang Chhu	Barme Chhu
5	Rora Chhu	Ponghi Rang chhu	Burum Chhu	Ranghap Chhu
6	Tarcham Chhu	Chhamam Chhu	Gey Chhu	Kau Khola
7	Ringni Chhu	Rathong Chhu	Tarum Chhu	Niya Khola
8	Lungze Chhu	Rodung chhu	Rabom Chhu	Ben Khola
9	Nahang Chhu	Relli Chhu	Lachen Chhu	Katlej Khola
10	Rongli Chhu	Rangit Chhu	Donkya Chhu	Seti Khola
11	Rashi Chhu	Pale Khola	Yumthang Chhu	Rabi Khola
12	Rangpo Chhu	Rimbi Khola	Sebozung Chhu	Ralu Khola
13		Nambo Khola	Toklung Chhu	Rayong Khola
14		Mardom Khola	Lachung Chhu	Pirchu Khola
15		Pharik Khola	Goma Chhu	Tre Khola
16		Simpak Khola	Phuthung Chhu	Manpur Khola
17		Simchor Khola	Lungma Chhu	
18		Bega Khola	Khora Chhu	
19		Dentam Khola	Naku Chhu	
20		Hi Khola	Langbo Chhu	
21		Kalej Khola	Lhinak Chhu	
22		Rashi Khola	Poke Chhu	
23		Roathak Khola	Thomphyak Chhu	
24		Kali Khola	Zemu Chhu	
25		Rabdi Khola	Ringpl Chhu	
26		Riyong Khola	Umram Chhu	
27		Rammam Khola	Rangyong Chhu	
28			Ralu Chhu	

Source: Topographical Map of Sikkim, Scale 1:1000000 and Choudhury Maitreyee, Sikkim Geographical Perspectives, 2006

IV. 1.ii. Underground Water

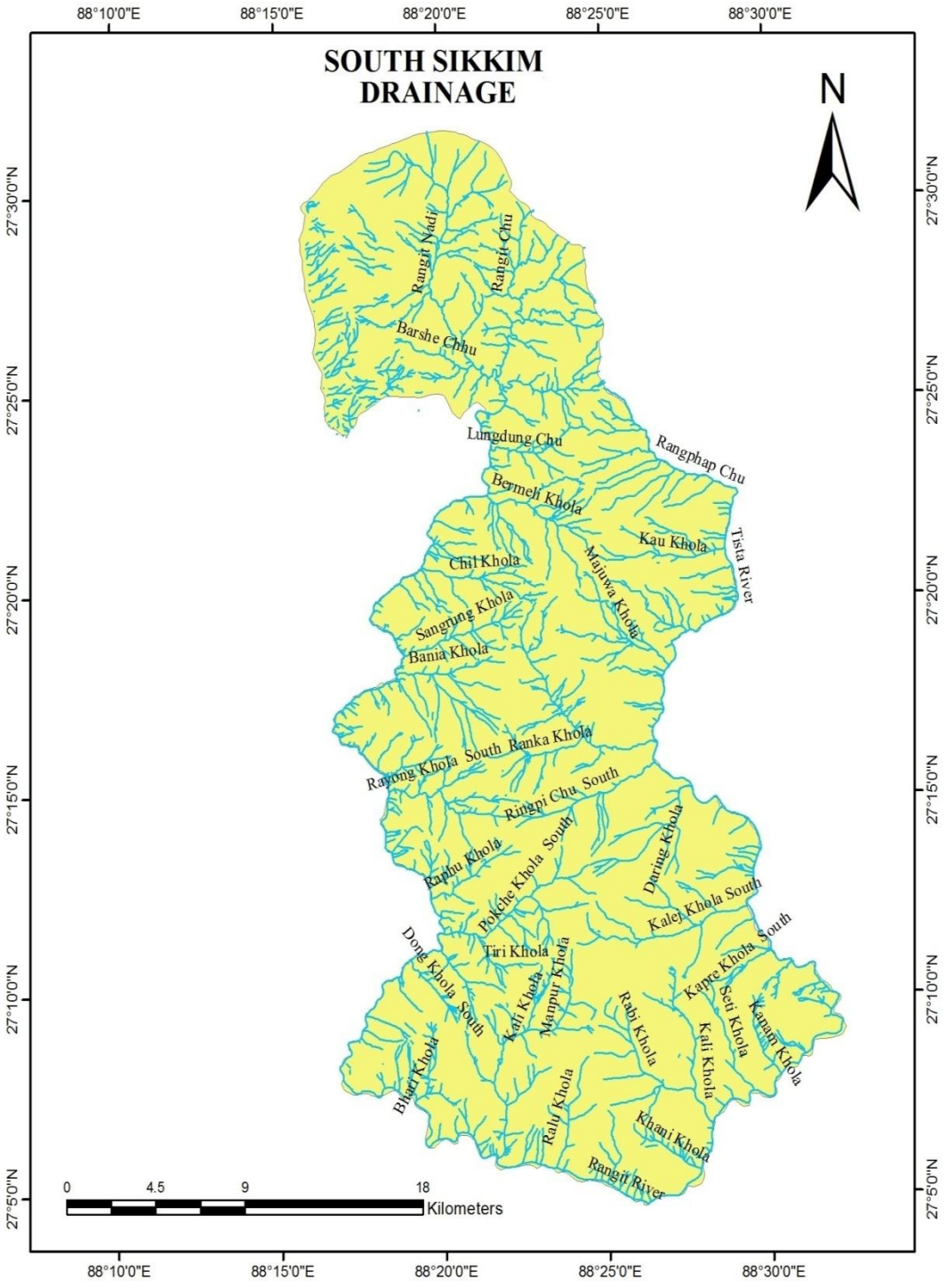
The net annual groundwater availability in Sikkim is 0.08 billion cubic metre (bcm). The availability of groundwater for both domestic and industrial uses is 0.01 bcm. The projected demand for domestic and industrial uses is 0.02 bcm and groundwater availability for future irrigation is 0.05 bcm. The stage of groundwater development in Sikkim is 16 percent (Central Ground Water Report Government of India, 2009 - 2010). The Central Ground Water Report of 2011 reveals that the net groundwater availability in Sikkim is 0.046 bcm. The total amount of groundwater availability for irrigation, domestic uses and industrial uses is 0.010 bcm. Within which availability of groundwater for irrigation constitutes 0.03 bcm and for domestic and industrial uses constitutes 0.07 bcm. The comparison of three years data on groundwater availability shows that the availability of groundwater is decreasing in Sikkim. In Sikkim, the total number of well drilled by the Central Ground Water Board till 31- 03 – 2011 is 31, but only 10 are in use.

IV. 2. Availability of Water Resource in South District of Sikkim

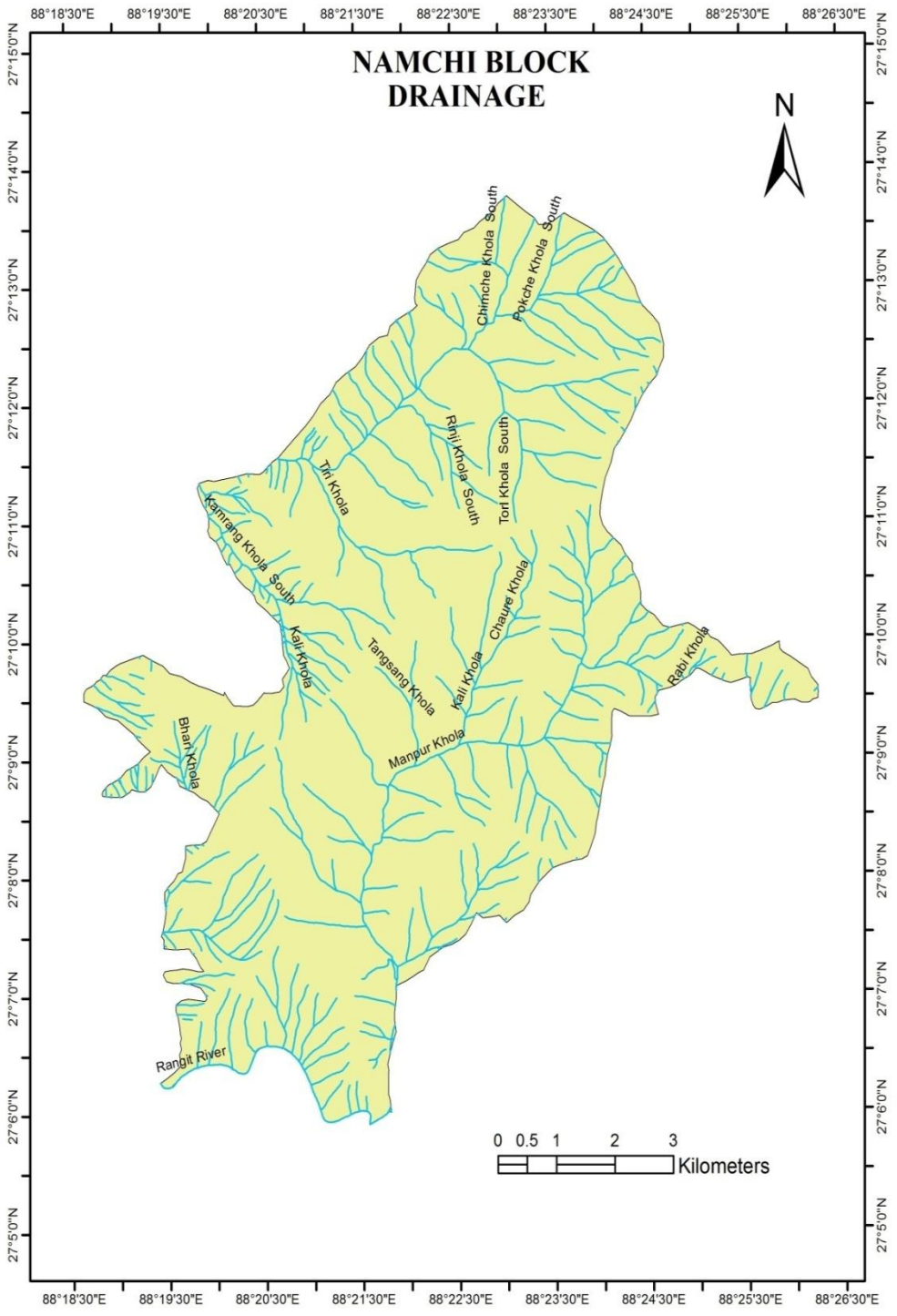
The availability of water resource in South Sikkim is mainly in the form of river, stream, springs and some amount of underground water. The underground water further depends on the types of aquifer and rock formation. The glaciers and natural lakes which feed the rivers and streams are confined in North and West districts of state. South Sikkim does not have such lakes and glaciers which could provide direct water for the human use. River Rangeet, the main tributary of the river Teesta flows as a boundary line between West and South district of Sikkim. River Rangeet along with its tributaries drain southern most part of the south district of the state. The tributaries of the river Rangeet which drain the different part of South district are Rangbhang, Relli, Rothang and Lale. The sub-tributaries are Kayanu chhu, Mingdung

chhu, Barme chhu, rangphap chhu, Kau [4]*Khola*, Niya Khola, Ben *khola*, Katlej *Khola*, Rabi Khola, Ralu *Khola*, Rayong *Khola*, Pirchu *Khola*, Tre *Khola*, Manpur *Khola*, Kauuchhu, Relli Chhu, Reshi chhu, Pabung *Khola* (Choudhury 2006)

[4] *Chu* and *Khola* is the local term used for the river



Source: Prepared by Author adapted from Department of Forest, Government of Sikkim, Gangtok.



Source: Prepared by Author, adapted from Department of Forest, Government of Sikkim, Gangtok

According to the survey of District Irrigation Plan South Sikkim under Pradhan Mantri Krishi Sichayee Yojna (PMKSY), the total water availability of South

Sikkim is 0.012936065 million cubic metre (MCM). The water available in various water bodies including rainwater harvesting or stored surface water is 0.01282 million cubic metres and water available in perennial sources is 0.000116065 MCM. Availability of water for the purpose of irrigation is represented by the irrigated area in a hectare. In respect to this in South Sikkim, the gross irrigated area is 1878 hectare, the net irrigated area is 1502.4 hectare and the partially irrigated area is 27.287 hectare.

Further, District Irrigation Plan of South Sikkim, have calculated water demands of South Sikkim, the present total water demand of South Sikkim for various sectors is 0.025508924 MCM. While domestic water requirement/demand is 0.01615350 MCM, crop water demand is 0.001178254 MCM, water demand of livestock is 0.00755560 MCM and industrial water demand is 0.00032307 MCM. It is further projected that the total water demand in the year 2020 would be 0.0806759144 MCM. This data suggest that day by day water demand in South Sikkim is increasing in every sector of consumption. The projected water demand for crop and domestic use is high as compared to other sectors of consumption.

Table 4.5: Rainfall Analyses of South Sikkim, 2005 -2014

Total monthly rainfall (in mm) of South Sikkim (2005 – 2014)										
Month	**Year**									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Jan	15.3	0	0	0	0	0	11.9	10	0	0.6
Feb	5.7	16.3	110.7	14	0	9.6	8.6	2.2	0.002	5.2
March	72.7	216.2	21.3	86	48.2	19.2	90.5	7.2	40.7	60.6
April	43.9	213	74.4	211.3	267.2	139.9	123.7	79.9	122.5	15
May	148.7	75.5	71.8	225.8	212.7	156.9	153.2	70.9	139.7	82.1
June	408	169.1	286.8	430.2	199.4	341.6	271.5	371.6	160.4	390.6
July	539.5	505.2	529.4	447.7	397	493.6	409.2	272.8	198.8	237.9
Aug	339.2	156.9	229.6	791.6	429.6	331.8	372.9	1089.1	232.45	253.9
Sept	123	452.5	967.7	64.7	192.4	486.4	281.1	319.8	85.8	223
Oct	43.8	0	48.6	10.5	200.1	16.3	9.6	2.2	65.2	14.4
Nov	0	8.5	0	0	0	0	0	0	8.2	0
Dec	0	0	0	11.5	0	0	0	0	6	1.8
Average	144.98	151.1	195.02	191.10	162.21	166.27	144.35	185.47	88.31	107.09
SD	182.65	175.12	289.36	248.91	154.38	195.43	152.68	316.18	81.79	133.69

Source: Computed by Author from data recorded in Part-time Weather Observatory Namthang, South Sikkim.

IV.3. Rainfall of South Sikkim

Table 4.5 reveals the monthly rainfall of South Sikkim which is recorded in part-time weather observatory Namthang, South Sikkim from 2005 to 2014. South Sikkim received overall low rainfall throughout the year as compared to the other districts of the state. The above rainfall data from 2005 to 2014 reflects that the districts received maximum rainfall from the month of April to September while between the months of October to March the district received very less rainfall.

Further, the data reflects that from the year 2005 to 2014, the highest rainfall received is 1089.1 mm in the month of August in 2012. On the other hand, South Sikkim does not receive any rainfall in the month of November for eight years, only in the year 2006, 2013 it received rainfall of 8.5 mm and 8.2 mm respectively. Similarly, the month of December had remained dry for seven years. Likewise, the month of January remained dry (no rainfall) for 6 years. The months of October and February witness very less rainfall in all most all year from 2005 to 2014. This shows that for six months (October - March) the South district remains dry. The Standard Deviation (SD) of rainfall data reveals that in the year 2007, 2008 and 2012, SD is far away from the mean, which indicates that in these years there is a high monthly variation in rainfall. In the year 2012, though the average rainfall is less i.e. 185.47 mm but the monthly rainfall varies from 0-1089 mm. In the year 2009 and 2013, SD is close to the average rainfall which indicates that there is a less variation in monthly rainfall.

Most of the streams are non-perennial in nature which only swells in monsoon season and in the dry period or scanty rainfall months, rivers and streams gets dry and the source discharge decreases. In the dry period, rural people do not even get a permanent water source to access water. Further, they do not get adequate water for their basic needs like domestic purpose and for livestock.

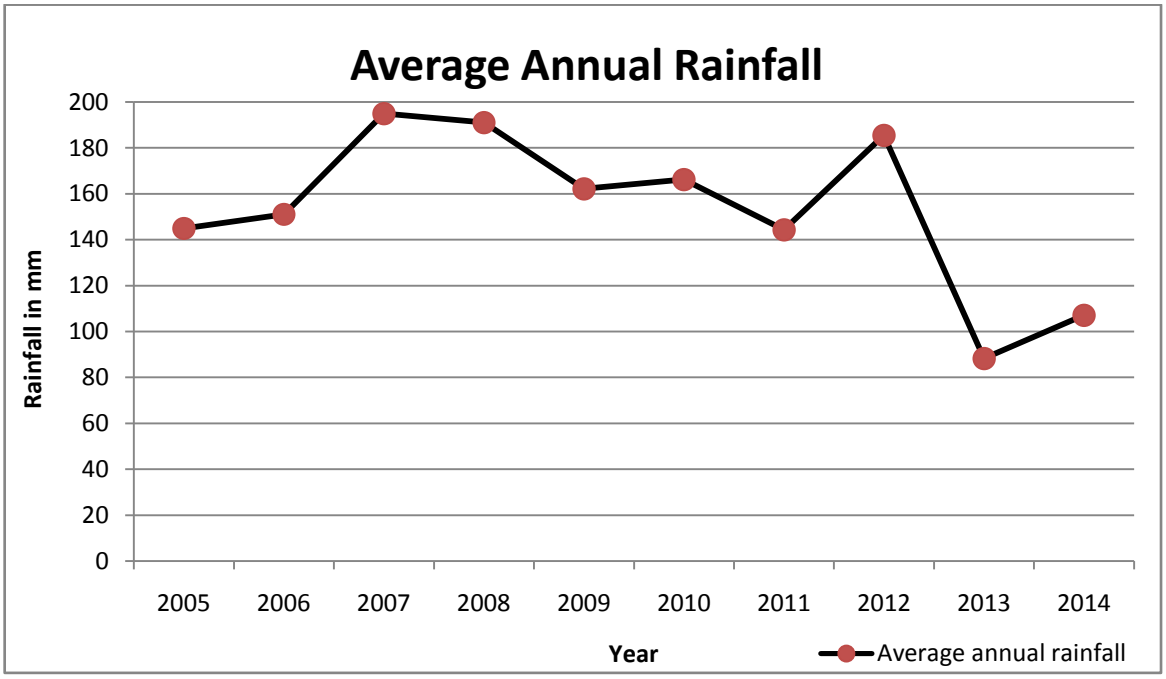


Figure 4.1: Trend of Average Annual Rainfall of South Sikkim, 2005-2014

Source**:** Computed by Author from the data recorded in part-time observatory Namthang, South Sikkim.

IV.3.i. Average Annual Rainfall

The trend of annual average rainfall between 2005 and 2014 reflects that South Sikkim received the highest rainfall in the year 2007 i.e. 195.02 (mm). While in the year 2013 it received very scanty rainfall of 88.31 mm. In 2005, 2011 and 2006 the area received the almost same amount of rainfall i.e. 144.98, 144.35 mm and 151.1mm respectively. The trend of annual average rainfall of South Sikkim reveals that there is increasing trend of rainfall from 2005 to 2007. While, from 2008 the amount decreases till 2011. Again in the year 2012, the rainfall increased as compared to previous years. Whereas in the year 2013 rainfall suddenly decreased and recorded only 88 mm which is just higher than the state minimum rainfall 82mm.

Overall, South district receives less amount of rainfall as compared to other districts of the state, as it falls under the rain shadow zone of Darjeeling Himalaya. Even there is a variation in the amount of rainfall received within a district, some blocks like

Namchi, Namthang, Sikkip, Jorthang, Malli receive very less rainfall and are considered as the drought-prone area by the Rural Management and Development Department Government of Sikkim.

IV.4. Availability of Water in Namchi

According to a survey of District Irrigation Plan South Sikkim under Pradhan Mantri Krishi Sichayee Yojna (PMKSY) 2016, the stored surface water of Namchi is 0.003 million cubic metre (MCM) which constitute 23 percent of the total water available in eight blocks of district. Water available for irrigation is represented by the irrigated area in a hectare, in this respect, the gross irrigated area of Namchi is 75 hectare, the Net irrigated area is 60 hectare and the partially Irrigated area is 5.122 hectare. Further, according to the District Irrigation Plan, the present water demand of Namchi is 0.00512884 MCM, where domestic water demand is 0.00354970 MCM, Crop water demand is 0.00003317 MCM, Livestock water demand is 0.00061249 MCM. There is no water demand for industrial purpose in Namchi. The total projected water demand of Namchi in the year 2020 is 0.0201392 MCM, wherein the projected water demand for domestic purpose is high as compared to other section of consumption.

Table 4.6: Monthly Rainfall of Namchi (in mm), 2011 – 2014

Month	Monthly rainfall in (mm) Year 2011-2014			
	2011	2012	2013	2014
January	NA	0	0	0
February	NA	6.5	6	5.5
March	NA	1.5	24.5	12.5
April	NA	82	24	1.5
May	NA	46	50	1.5
June	NA	41.5	60	9
July	NA	70.5	52.5	38.5
August	112.5	02	60.5	144.5

September	102.5	66	14.5	53
October	16	5.5	51	9
November	13.5	0	0	0
December	1	0	0	1.5
Average	-	26.79	28.58	23.04
SD	-	32.12	24.74	41.73

Source: Computed by Author from daily rainfall data recorded in automatic weather observatory, Maniram Phalidara, Namchi (Station ID -A0AD4E5A).

4.4.i. Rainfall Analysis of Namchi

The above rainfall data of Namchi is collected from the automatic weather observatory, Maniram Phalidara, Namchi. The close inspection of the above monthly rainfall data of Namchi reveals that even in the monsoon season i.e. from the month of May to September, Namchi received very less rainfall minimum rainfall of 1.5mm and maximum of 144.5 mm. The annual and monthly variation of rainfall is highly observed. The above three years rainfall data reveals that Namchi block did not receive any rainfall in the month of November, December and January. During these months the springs and streams are highly affected by rainfall. Further, due to no rainfall the discharge of water in the source remains low and the seasonal streams and springs get dry which causes a water shortage in both rural and urban areas. The availability of water in the form of rainfall is low in the winter season. In monsoon season it is high but the availability of utilizable water is low, as water distribution channel gets disturbed and becomes muddy and also most of the rainwater gets lost through surface runoff.

The analysis of annual rainfall data for the period of three years reveals that in the year 2012, Namchi block received highest rainfall of 82mm which is equal to that of state lowest rainfall. Similarly, in 2013 Namchi received the highest rainfall of 60.5 mm

which is almost 20mm lower than the state's minimum average rainfall. Likewise, in the year 2014, the highest recorded rainfall is 144mm. An average annual rainfall recorded in the year 2012 is 27mm, in the year 2013 it is 29 mm and in 2014 it is only 23mm which is much lower than the state and district lowest rainfall. This trend of three years of average rainfall shows that though the rainfall received by the area in 2014 increase as compared to preceding year but only 2 mm while it has decreased in 2014 by 6mm.

In the year 2012 and 2013, the mean annual rainfall is close to the standard deviation which denotes that there is not much variation of monthly rainfall. Contrary to this, in the year 2014 standard deviation is relatively higher which indicates a large variation of monthly rainfall. Overall, Namchi has been receiving very less rainfall and this is one of the important factors for water shortage in Namchi.

The amount of rainfall received in an area determines the availability of both surface and groundwater in that area. Recently the Government of Sikkim under MGNREGA program has constructed trenches to collect the surface runoff for the recharge of groundwater under Rejuvenation of Drying Springs schemes under Rural Management and Development Department, Government of Sikkim and the outcome of the schemes also depends on the amount of rainfall received.

IV. 5. Sources of Drinking Water in Sikkim

The main source of drinking water in both rural and urban area of Sikkim is tap water, spring, covered and uncovered well, river, and other[5] sources. Sikkim is a hilly state so the source of water like tube well, bore well, and hand pump is not applicable. The main sources of drinking water are presented in the table below.

[5] Other sources - includes those cases where drinking water is made available by tanker or bottled water is used by the households.

Table 4.7: Main Source of Drinking Water in Sikkim

State/Rural/Urban	Tap water from treated Source	Tap water from untreated Source	Covered well	Uncovered Well	Tube well/ Bore well/	Hand pump	Spring	River	Tank/ Pond/ Lake	Others
Sikkim Total	29	56	0.4	0.2	0	0	11	0.4	0.6	2
Rural	13	69	0.3	0.2	0	0	13.	0.6	0.8	2.6
Urban	70	22	0.9	0	0	0	6.4	0	0.1	0.3

Source: Census of India, 2011 Sikkim, District Census Hand Book, Series 12, Part XII-B

In Sikkim most of the households access drinking water from the tap (both water without treatment and with treatment). Amongst these sources, tap water is the main sources of water since, 85 percent household are consuming drinking water from the tap. Amongst the households access water from the tap 29 percent access from the treated source and 56 percent access from untreated source. Further, there is a great variation in urban and rural water access from treated source and untreated source. Around 70 percent of the urban households in Sikkim are accessing drinking water from the treated source, as in most of the urban areas Water Security and Physical Health and Engineering Department (PHED) are supplying drinking water after proper treatment in the reservoir. Contrary to this, in the rural areas only 13 percent households are consuming drinking water from the treated source. This scenario reflects that, while focusing more on the urban amenities and development, the concerned department pays less attention to the health of the rural population.

In Sikkim, people access drinking water from various other sources like springs, rivers, tank, pond, lake and wells. A significant number of households of Sikkim access drinking water from the spring, in which 13 percent are rural household and 6 percent are urban household. The rural households which are near to the river or in down streams are able to access water directly from rivers for their daily consumption though such

households account only 0.6 percent. Besides, people are also consuming water from tanks and natural lakes for domestic purpose.

Table 4.8: Percentage of Drinking Water Source Availability in South Sikkim and Namchi block

` District/ Sub - District	Within Premise	Near Premise	Away
South Total	60.5	25.6	16.1
Rural	57.6	30.4	12
Urban	76	19.3	4.7
Namchi	57.1	30.1	12.8
Rural	51.4	33.4	15.2
Urban	76.0	19.3	4.7

Source: Computed by Author from data provided in the Census of India, 2011 Sikkim, District Census Hand Book, Series 12, Part XII-B

Out of the total households, 60 percent are having drinking water source available within premises in South Sikkim. Similarly, one–fourth of households have the source near premises and 16 percent have away. Further, within South Sikkim in urban areas more than three–fourth of households have access to drinking water within premises while in rural area only half of the households have access to water within premises. This means a large number household in rural areas are spending the time to access water from the source located away from the home.

Tables 4.8 further demonstrate that in Namchi only 51 percent of the rural households have water source available within premises. While in urban areas it is 76 percent. The rural households having water sources away from home account 15 percent which is almost four times higher than urban household with water source away from home.

Table 4.9: Percentage of Household Accessing Drinking Water from Different Sources in South Sikkim and Namchi Sub Division (%)

District	Total No. of Household	Tap water from treated Source	Tap water from untreated Source	Covered well	Uncovered Well	Tube well/ Bore well/	Hand pump	Spring	Rivers/ Cannel	Tank/ Pond/ Lake	Others
South Total	30246	8,307 (27.5)	19203 (63.8)	35 (0.1)	27 (0.09)	5 (0)	1 (0)	1988 (6.6)	80 (0.3)	99 (0.3)	411 (0.4)
Rural	25476	3,998 (15.7)	18,983 (74.5)	35 (0.1)	27 (0.1)	5 (0)	1 (0)	1,870 (7.3)	79 (0.3)	97 (0.4)	381 (0.5)
Urban	4,770	4309 (90.3)	310 (6.5)	0 (0)	0 (0)	0 (0)	1 (0)	118 (2.5)	1 (0)	2 (0.4)	30 (0.63)
Namchi Total	20,594	7,045 (34.2)	11,760 (57.1)	19 (0.1)	9 (0.1)	2 (0.01)	0 (0)	1300 (6.3)	67 (0.3)	82 (0.4)	310 (0.5)
Rural	15824	2736 (17.3)	11,45 (72.4)	19 (0.1)	9 (0.06)	2 (0)	0 (0)	1,182 (7.5)	66 (0.4)	80 (0.5)	280 (0.8)
Urban	4770	4,309 (90.3)	310 (6.5)	0 (0)	0 (0)	2 (0)	0 (0)	118 (2.5)	1 (0)	2 (0)	30 (0.65)

Source: Computed by Author from the Rainfall Data Recorded in Part-Time Weather Observatory, Namthang South Sikkim

IV.6. Sources of Drinking Water in South Sikkim and Namchi

According to the secondary data, tap, springs, rivers, are the important sources of drinking water in South Sikkim. Out of the total households in South Sikkim, 90 percent access tap water. Other than this source, 7 percent household access water from spring. On the other hand percentage of household access water from rivers, tanks, lakes, and ponds are very less. In rural areas of South Sikkim, only 16 percent households have access to drinking water from the treated source and remaining three-fourth are consuming tap water from the untreated source. Besides these sources, very few households access water from wells and other sources.

Similarly, in Namchi 91 percent households are using tap as a main source of drinking water. Amongst this 34 percent consuming drinking water from the treated source and 57 percent are from the untreated source. Further, only 6 percent household access drinking water from natural springs. In Namchi a very insignificant number of house access drinking water from the river and natural lakes/ ponds. Moreover, in rural area around 89 percent households access water from tap but in urban area it is 97 percent. In rural area only 17 percent households access water from treated source on the other hand in urban area 90 percent household access water from treated source.

Spring is a second important source of drinking water for rural household of Namchi; around 8 percent of households are consuming water from natural springs. Households near to the river are directly consuming water from river which accounts 0.3 percent to the total rural households. In urban areas 90 percent household is accessing tap water from the treated source.

The above interpretation of secondary data revealed that the tap is the main source of drinking water for both the rural and urban households in Sikkim, South

Sikkim and even in Namchi. Further, a large majority of rural households access drinking water from untreated source in state, district as well as in the block level. Furthermore, a large number of rural household access drinking water from the source located far away from the home. While in the urban area, more than three-fourth households have water source available within premise. Rural households are consuming drinking water from untreated source whereas in urban area almost all the households consume treated water.

Drinking Water Sources of Rural and Urban Households of Namchi, Census, 2011

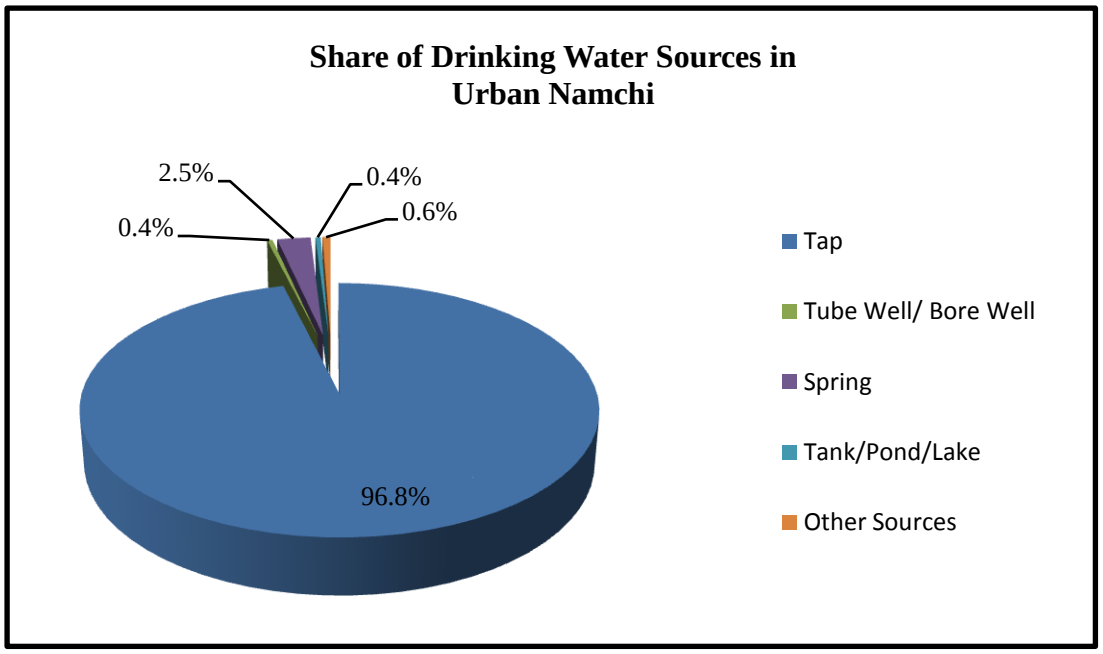


Figure. 4.2: Sources of Drinking Water in Urban Area

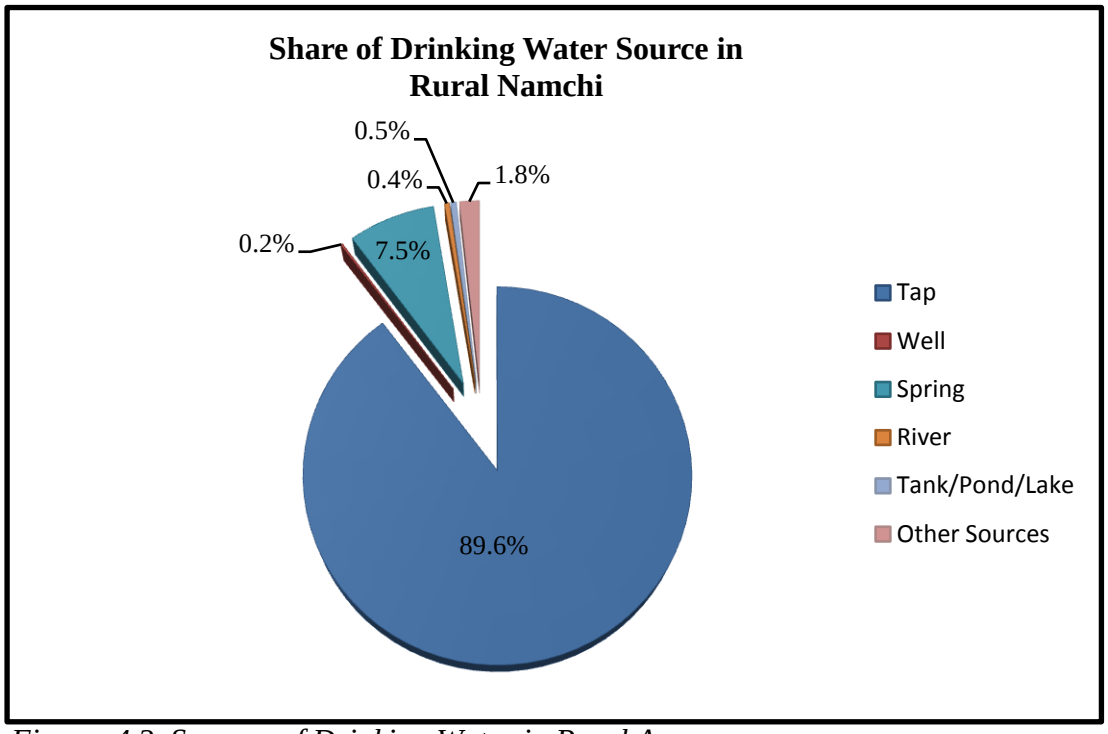


Figure. 4.3. Sources of Drinking Water in Rural Areas

IV.7. Water Availability and Access

Namchi is said as one of the driest parts of South Sikkim, where water is available only in the form of small streams and springs. Availability of perennial water source is very less in Namchi as most of the streams and springs are seasonal in nature which gets swell only in monsoon season. Only the southern most part of Namchi is drained by the river Rangeet. So, in almost every village water is made available by carrying it from a far distance source and collecting it in a tank. So, in the present study the source of water means the main source from where household tapped water like government community tank, streams and spring. But in Census data the tap which is connected to almost every household is considered as source of water. Though 90 percent of household in both rural and urban area have access to tap water the supply is not regular. The household having water source away from the premises are collecting it from distance sources like streams, springs and ponds. The secondary data reflects 100 percent habitation coverage to water connection and

supply to rural households but the real ground situation is different. In reality it is just an adjustment made by people with the supply.

IV.8. Availability and Access of Water at Household Level

The following paragraphs will contain discussion on availability of water source, access and supply condition of water amongst the household. Public participation is an important aspect in resource conservation because they are close to nature and they have a better idea to manage it in judicious manner. Here, the analysis also provides insight into the level of public participation in water management especially with respect to gender issue. The study further attempted to know about the Government Schemes for sustainable water management in sample villages.

The study demonstrates that almost every household have water source except three household. These three household have depends on neighbor household for their water requirement. More than 95 percent households have perennial source. This large number is because in almost all the surveyed villages water has been taped from the perennial sources located approximately 6-8 km distance from the village. Further it is stored in the tank located within the village and from the tank water is connected to household. This mechanism of tapping water from the perennial source to the tank is done by the villager with the support of RMDD, Government of Sikkim. In Rong, Singithang and Lower Phalidara few households have taped water from one or two non perennial streams within the village. Furthermore, household located in upper ridge of Upper Kitam, Upper Sorok are facing water crises throughout the year because these are located above the source.

Every household are access to water in the rural area, either from the stream, spring or government community tank.

Table 4.10: Distribution of Households by Mode of Access to Water

Source of household water connection	No. of households	Percentage
Spring	35	19.4
Stream(kholsha)	21	11.7
Government community tank	116	64.4
Both Private and Govt. tank	8	4.4
Total	180	100

Source: Field Survey, 2015-2016

Springs, Stream and Government community tank are the main source of water in the surveyed villages. Table 4.10 reflects that more than three-fifth of the household access water from government community tank. Government community tank here means the tank constructed by the Government with the labour support from local people. The source of the tank water is perennial streams. Besides this people have collectively constructed water tank by generating fund, construction material and labour to store the over flow from the main tank. In this regard, one of the respondents in upper Kitam said that

> *"To collect the overflow water from the main tank we have constructed tank by collecting an amount of Rs. 300 from every household as well as construction material like timber, bamboo etc". Padhmashila Pradhan, Upper Kitam, 20th December 2015*

Access to spring is the next important source of water which account on an average 19 percent of household's main water supply. Streams (khola) are another important water source for 12 percent of the respondent household. Households accessing water from both private tank and government community tank are very few in number. Some of the water sources like well, tube well, bore well which is mentioned in the census data are not found in the surveyed village.

From these above mentioned sources households have access or connect water through different modes. The detail description of the types and mode of water connection will present in the next paragraph.

Table 4.11: Distribution of Households by Types of Water Connection

	Households					
Types of water connection	Total	Percentage	BPL	Percentage	APL	Percentage
Private connection	87	49.43	49	47.11	38	52.77
RMDD Government connection	57	32.38	41	39.42	16	22.22
PHED Government connection	21	11.93	7	6.73	14	19.44
Private and RMDD	5	2.84	3	2.88	2	2.77
Private and PHED	2	1.13	0	0.0	2	2.77
PHED and RMDD	1	0.6	1	0.96	0	0.0
From other households	3	1.7	3	2.88	0	0.0
Total	177	100.0	104	100.0	72	100.0

Source: Field Survey, 2015 -2016

Table 4.11 reflects the different types of water connection amongst the respondent household from the above mentioned sources. Amongst the respondent household, 98 percent have water connection amongst which 49 percent have private connection. Private connection here means the connection of water in the households by their own expenditure, without any external support. It includes the water connection from springs, streams (Khola) and from Government community tank. The household who have spring as a source of water have connected water pipeline from the spring to the house privately. Similarly, some of the household accessing water from Government community tank have connected water pipeline from the tank to the house in own expenditure. Hence, it is considered as a private connection.

Besides, above mentioned types of connection, households also have RMDD and PHED connection. The RMDD and PHED connection means a water connection provided exclusively by government. RMDD is the government department which is responsible for providing service related to the rural development like water security, rural housing, sanitation and construction of village infrastructure. So, this department takes care of development of water infrastructure like construction of water harvesting tank, household water connections, construction of pits and trenches in the upper catchment for rejuvenation of springs, streams and lakes in the rural area. Similarly, in the urban area PHED the government department is responsible to provide water service to the households. Though there are two service providers in the area, none of them provide regular water supply.

Though the concerned department for water supply in rural area is RMDD, the PHE department is also supplying water in the study area. This is because in Upper Sorok and Singithang village, households which are located above the water source and near to the urban area are having urban water connection. The study shows that 32 percent of household have water connection provided by RMDD from the government community tank. Such households are getting water supply only morning 30 minutes – 1 hour. While on an average 12 percent households have water connection from PHED. Even the households having water connection from PHED do not get regular supply. The supply is once a week that too is for 30 minutes. Hence, they are fulfilling their water demand by collecting water from distance sources.

Though there are two water service providers involved in the villages, supply is not regular as well as not for round a clock. There are three low income households who have water connection from neighbors. Due to the water shortage, people started migrating towards catchment area.

"For washing clothes, we do travel 1km distance to Ralep Dahra (spring)". My daughter Mahima do collect water whole day during winter Vacation. For more than 7 months (Nov – May) we fulfil our water requirement by fetching water from a different distance. Binita Rai, Upper Sorok Village, date: 9th January 2016.

"I have constructed my house near to stream just because of the present water shortage problem and for future concern. As I have recently migrated from near Namchi bazaar because of water scarcity. Now I am having private connection". Grim Chandra Rai, Upper Sorok village, Date: 7th of January 2016.

Table 4.12: Distribution of Household by Number of Water Connection

No. of connection	No. of HHs	Percentage	BPL	Percentage	APL	Percentage
1	151	83.9	94	90.38	57	79.16
2	24	13.3	9	8.65	15	20.84
3	1	0.6	1	0.96	0	0.0
Total connected HH	176	100.0	104	100.0	72	100.0

Source: Field Survey, 2015 -2016

There is a disparity in the number of water connection, as some households do not have water connection and some others have 2 to 3 connections. This disparity is seen because some of the high incomes household who are having a private connection also have a Government connection. The respondents have reported that due to insufficient and irregular water supply from government they have connected water privately. The above table 4.12 reveals that 84 percent household has single water connection and 13 percent have double connection. Amongst the households who have double connection, majority of them are APL households.

IV. 9. Water Supply

Water supply in rural household is provided by the RMDD, Government of Sikkim but in the study area the household located near to the urban area have urban water supply. Table 4.10 shows that almost all the household have water connection even the Census data on source of drinking water shows 100 percent water connection to the household which is true but in reality supply is not regular. Only those household who have the water connection directly from streams and springs are having daily round a clock supply. Households who have water connection from Government community tank do not get regular supply. Water supply status of respondent household is presented in the table below.

Table 4.13: Distribution of Households by Availability of Water Supply

Mode of supply	No. of Households	Percentage
Regular [6] Supply	119	67.6
[7]Irregular	57	32.4
Total	176	100.0
No of days water supply per week to HHs		
Once a day/ daily morning	70	39.77
For a few minutes twice a day	6	3.41
Once in two days	40	22.72
Once in three days	5	2.84
Twice a week	7	3.97
Once a week	5	2.84
24 hours/round the clock	43	24.43
Total	176	100.0

Source: Field Survey, 2015-2016

[6] Regular supply means household who get daily one time water, few minutes twice a day and 24 hours supply.

[7] Irregular supply means household who gets water in alternate day, once in three days and twice a week.

Water supply in rural Namchi here includes both the government and private supply. Water in the most of the village is made available by the government by carrying water from far distance sources, ranging from 5km to 15 km distance from the village and is collected in Government community tank. From the community tank, in some villages like Upper Kitam and Lower Phalidara, RMDD have connected water to every household except households located above the source or tank. But in other villages like Rong, Singithang people have connected on their own expenses. Out of the surveyed households, 4 percent do not have a water supply on their premises and they are surviving by fetching water from different outside sources.

Here, the households having continued water supply includes (Households with one-time water supply per day, twice a day supply and 24 hours supply) which constitutes around 68 percent. Households having 24 hours water supply are those who have privately connected water from the spring and stream and are near to the source. But those households who have privately connected water from the community tank are having one time supply per day. Some of the households are getting one-time water supply per day in the morning and some others are getting once in two days or three days per week that too it is for 30 minutes to 1 hour. These household are running by fetching water.

Overall, around 45 percent household have a daily one time water supply while on an average 32 per cent have supply varies from thrice per week to once per week.

It was observed during the field survey that there was no similarity of water supply timing found in the surveyed village because the size of the water tank and a number of household access water from Government community tank varies from one village to another. For instance, in Upper Kitam, households below the water tank are

getting one-time water supply daily, whereas in Singithang they are getting once in two days. There are 9 household in upper part of Upper Kitam and 8 households in upper part of Upper Sorok who are most vulnerable to water shortage, they are sustaining their livelihood by fetching water from seasonal stream located in different distance from the village. Though these households have water connection, the supply is very irregular i.e. once or twice a week that too for less than 30 minutes.

Overall, twenty-four hours of water supply even in a rural area is a dream for a majority of households. Since more than 75 percent of rural households are not getting 24 hours water supply.

In almost all the village, households having water connection from community tank are paying monthly water charge fixed by the respective committee. The detail of which will be discuss in the Chapter VI. In Rong village households who do not have connection from the tank are also paying Rs 25 per month as water usage charge in Panchayat office. To ensure the equal distribution and to avoid the conflict among the households, villagers in most of the village have nominated one person on monthly payment basis to open and close the main distribution valve in the morning. This nominated person opens the valve early in the morning at around 7 o'clock for every connected household for around 30 minutes to 1 hour. The monthly salary of person is made from the collected water charge.

"*There used to be conflict regarding water distribution. So to avoid conflict amongst the villagers, we 12 HHs have conducted the meeting on 12th November 2014 and have nominated one person as a fitter or water watchman to open the valve equally for all member households for equal duration of time.. Futher, we decided and started collecting Rs 25 from each HH to make payment to the fitter i.e. Rs 300/Month. For other repairing purpose we do collect money when it is needed. After this initiative, we are getting an equal amount of water and as a result of this any sort of conflict has not been reported". ....Bhagat Ram Rai, Rong Village, Date: 7th December 2015.*

Table 4.14: Distribution of Households by Duration of Water Supply

Water Supply Timing (in minutes/ hours)	No of Households	Percentage
Below 15 minutes	8	4.54
30 minutes	25	14.2
31 minutes to 1.30 hours	77	43.75
1.30 to 2.30 hours	16	9.0
2.30 to 3.30 hours	3	1.7
3.30 to 6.30 hours	4	2.27
24 hours	43	24.43
Total	176	100.0

Source**:** Field Survey, 2015 -2016

Table 4.14 shows the duration of water supply amongst the respondents households. Though all the households are getting water the duration of supply varies. The data shows that around 44 percent of the respondent households are having water supply for one and half hours per day while 14 percent are getting for only 30 minutes per day. On an average 11 percents households are getting 2 – 3 hours of water supply per day while 4.5 percent are getting less than 15 minutes. Those households who are

near to the source and have a private connection from streams and springs are having 24 hours of water supply which constitute 24 percent to the total.

The existence of disparity in water supply in terms of duration is due to the differential rules of Water Management Committee which are formed in the villages. For instance in Rong village all the households who have a water connection from the Government community tank are getting 1.30 hours of water every morning. While in Upper Kitam it is for 30 minutes. On the other hand, in Upper Sorok and Singithang it is for less than 30 minutes. So, to have water in non supply days, households store water in every possible container**.**

The above discussion reveals that there is no social and gender discrimination in term of access water in the rural area. Disparity has been observed in term of duration of water supply which is mainly due to the differential rules of Water Management Committees. In addition to this the households who have water supply for more than two hours are high income.

Table 4.15: Storage Facilities

Types of Storage	Rubber Tank	Cemented Tank	Both (Rubber& Tank)	Drum	Bucket	Jar	Total
No. of HH	102	47	18	4	7	2	180
Percentage	56.7	26.1	10.0	2.2	3.9	1.1	100.0

Source**:** Field Survey, 2015 -2016

A storage facility here means availability of any kind of water storage container in the households whether it is private or government provided. In Namchi all the households stored water, whether it is of 24 hours supply or 15 minutes supply or not having any supply on the premises. People do store water in every possible container like bucket and Jar of 2 – 5 litters. The above table 4.15 reveals that more than half of the household have rubber tank and more than one – fourth of households

have cemented tank to store water. Some of the households do not have large container for water storage because of their economic condition and are storing it in a jar for two to three days.

Table 4.15.i: Distribution of Households by Water Storage Owned Types

Storage Owned	No. of Households	Percentage
Private	131	73.0
Government Provided	36	20.0
Govt. & Private	13	7.0
Total	180	100.0

Source**:** Field Survey, 2015-2016, *HH – Household

The Government of Sikkim, Rural Management and Development Department (RMDD) have constructed cemented water storage tank and provided a rubber tank in every village with the motive of providing water security in the water-scarce villages. The rural people of Namchi are more conscious towards the judicial use of water and its management, as almost three– fourth of households have private water storage facility and only 36 have government provided water storage facilities (including rainwater harvesting tank of large volume and household water storage tank). Further, 7 percent households have private and government provided storage facilities.

Though the scheme (distribution water harvesting tanks and household water storage tanks) is designed for low income group, middle and high income groups grab these schemes. For instance only 6 low income households are benefited as compared 27 middle income households and few high income groups.

Table 4.15.ii: Distribution of Households by Storage Capacity in Litre

Storage Capacity (in litre)	No of Households	Percentage
No storage facility	1	0.6
Below – 450	13	7.2
500 – 1000	47	26.1
1001 – 2000	37	20.6

2001 - 3000	14	7.8
3001 - 4000	9	5.0
4001 – 5000	18	10
Above 5001	41	22.77
Total	180	100.0

Source**:** Field Survey, 2015 -2016

In the winter season or in the lean period, non-perennial rivers are drying up and the volumes of even the perennial rivers decreases and are creating water shortage problems in rural areas. Hence the rural people of Namchi do store water throughout the year in every possible container. Peoples of all economic standards have got water storage facility, depends on the level of their affordability. Table 14.5.ii reflects that 7 percent of households have got maximum of 450 litres of water storage facility and these are low income groups. More than half of the surveyed households have got 500 to 3000 litres of water storage and 22 percent households have got more than 5000 litres of water storage.

IV.10. Purpose of Use of Water

The stored water is used for different purposes like for domestic purpose, watering vegetable, watering flower and livestock. Amongst these purpose of use, majority of the household use water for domestic and watering flower. The rural households are managing to use water for vegetable from stored water. Further, the households are growing only rain feed crops. Though almost all the household use water for watering flower, a majority of them use waste water of kitchen for this purpose. In Upper Kitam, Upper Sorok and Lower Phalidara village almost all the household use water only for the purpose of domestic and livestock while in Rong and Singithang village majority of household use for domestic, livestock, vegetable and flower.

Table 4.16: Distribution of Households by Use of Water for different Purposes

Purpose of Use	No. of HHs	Percentage
Domestic, Livestock, Vegetable and Flower	65	36.1
Domestic, Livestock and Flower	44	24.4
Domestic and Flower	46	25.5
Domestic, Vegetable and Flower	12	6.6
Domestic and Livestock	05	2.7
Domestic, Livestock, Flower and Commercial	04	2.2
Domestic, Livestock, Vegetable, Flower and Irrigation	01	0.5
Only Domestic	03	1.6
Total	180	100.0

Source: Field Survey, 2015-2016

The purpose of use of water is a very important indicator for studying the farming practice and quantity of water availability. If the percentage of the households using water for irrigation purpose is high then one can easily trace out that the area is practicing wet farming. In the rural areas water is being used for different purposes like for domestic purpose (includes drinking, cooking, washing utensils, personal hygiene and cleaning house), watering vegetable, watering flower, irrigation, livestock. The study reveals that majority of the households use water for domestic purpose, livestock and watering flower. Likewise, around 25 percent household use for domestic purpose and watering flower. Overall, on an average 92 percent household use water for the combined purpose like domestic, livestock, vegetable and flower. The use of water for vegetable is not regular. The watering of vegetable is done once a week or once in a fifteen days. Similarly, watering of flower is not a regular practice; they pour water once in two days. The water is use regularly only for domestic use and for livestock.

IV.11. Water Fetching Practices

Though almost all the household have water connection at their premises the supply is very irregular and inadequate, for instance once per day, once in two days, twice a week. So to make water available in non supply days for their household needs people collect water from different distance sources. On an average 54 percent of the total respondent household collects water. Amongst which around 70 percent are low income groups.

"We are fulfilling our daily water requirement through daily fetching. Two persons from the family do go for water fetching 7 times a day. We do feel health problem by consuming this water. For washing clothes, we go to the source itself". Man Badhur Rai, Upper Sorok village

"I can get chance to collect water only if I wake up early morning 4 AM". Sumitra Pradhan Upper Kitam village

"My granddaughters fetch water four times a day. In the morning before the school time two times and in the evening two time. We do not have a water supply at premises". Man Maya Subba, Upper Kitam

"I don't have water connection; I do fetch water to fulfil my domestic water requirements. I spend more than 3 hours daily to collect water and collect 150 litres of water per day. For washing and bathing, we go to the source itself. In my observation there will be no water in future as water sources are subsiding day by day". Subash Rai, Singithang village 13th January 2016

Table 4.17: Distribution of Households by Distance Covered for Collection of Water

Distance in (KM)	No. of Household	Percentage
Below 0.5 km	59	60.20
0.6 – 1 km	22	22.45
1.1 – 2km	10	10.20
2.1 – 3 km	6	6.12
Above 3 km	1	1.02
	98	100.0

Source: Field Survey, 2015 -2016

In the study area, people travelled a different distance to collect water to fulfil their daily water requirements. Moreover, in the lean period (from November – April) people face acute water scarcity. During these months the seasonal streams dry up and rainfall is not recorded in these months. Because of this reason more than three – fifth of households travel up to half kilometre distance to collect water daily for several trips. Similarly, around 34 percent households covered up to 1 km distance, two to three trips daily. Even significant number of households travelled 2 – 3 km distance to fetch water for their daily consumption.

Table 4.17. i: Distribution of Households by Number of Trip and Time Taken for Water Collection

No. of Trips/day	No. of HHs	Percent	Total Time taken for total trip	Percent
1	25	25.51	Below 30 minutes	32.29
2	49	50.0	30 -1 hour	34.37
3	13	13.26	1 -1.30	6.25
4	5	5.10	1.30 – 2	11.45
5	3	3.06	2 -2.30	3.12
7	2	2.04	2.30 - 3	6.25
14	1	1.02	Above 3 hrs	6.0
Total	98	100.0		100.0

Source: Field Survey, 2015 -2016

It is not only that people travel far distance to collect water but they have to cover this distance twice or thrice a day. The above table 4.17.i reflects the number of trips people make to collect water and total time taken for such trips. Firstly, the data on a number of trips for water collection per day reveals that half of the surveyed households make two trips to collects sufficient water per day. Similarly, 25 percent household make single trip to collects water. Further, around 23 percent household make 3 – 7 trips to bring water for their daily consumption. So engaging oneself from the productive time for a whole day to collect water is not only the economic loss but also physical stress. A close look at the data indicates that on an average 67 percent household spend 1 hour per day for water collection. Similarly, a significant number of households spent up to 3 hours and one household spend more than 3 hours for 14 trips per day to collect water. From this household two member collect water 7 times each so all together they collect14 trips. It was revealed during the interaction with the people that in the dry period the task of one or two persons from each of the households is to collect water whole day. This is how rural people managing water to their daily water demands.

"I don't have water connection at my home, as my home located above the source, I could not buy a motor to pump water. We fetch water from the nearby source daily 7 times; on an average, we do collect 210 litres water/ day. For washing clothes, we go the source". Til Badhur Bhujel, Singithang village 14th of January 2016

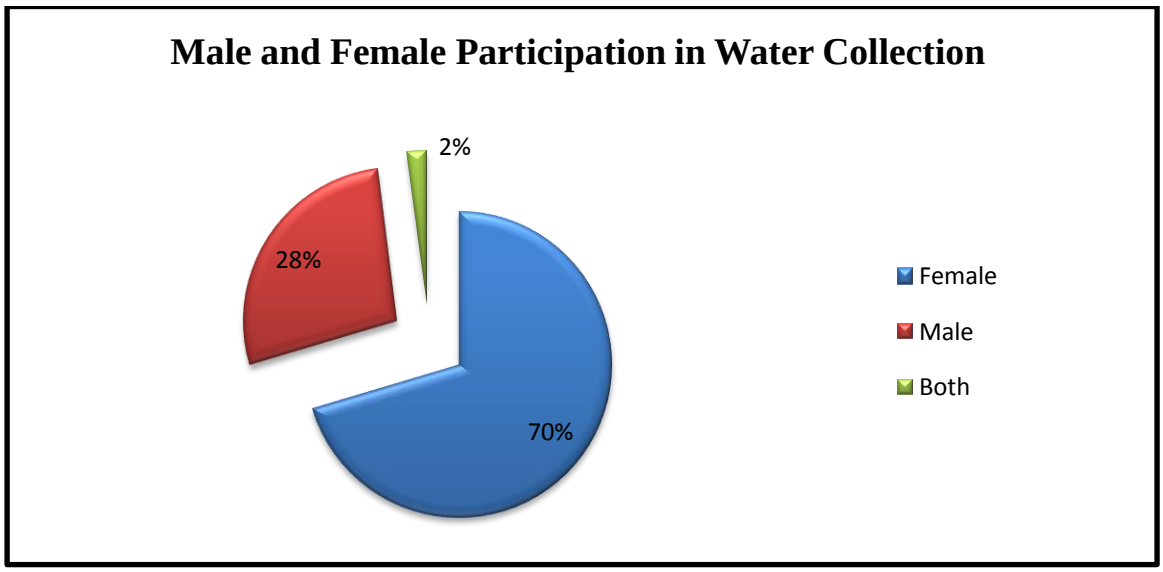


Figure. 4.4 Participation of male and female in water collection

Source: Field Survey, 2015 -2016

To know the role of women in water management, data has been collected on male and female participation in water collection as the contribution of the female in resource management especially water resource management has been mostly overlooked. The females are playing a vital role in managing water resource for their families and even to the society as a whole. It is primarily women who bear the daily burden of hauling heavy buckets of long distance to meet the domestic water needs of their families (Reddy and Dev 2006, pp -249). Women play a vital role as a water collector and users. Women are considered as privileged water manager in the concepts of 'ecofeminism' which tend to position women as natural caretakers of the environment because of their childbearing and nurturing roles. Women and girls are responsible for collecting water for domestic needs, (drinking, cooking, cleaning, washing) –work that is unpaid and time-consuming, (Ahmed 2006, pp 254-263). Although the participation of women in pipeline maintenance work is lesser than male but their participation in water fetching is higher. The Figure 4.4 demonstrated that

out of the 98 water fetching households, female from 70 percent household have participated in water collection and male from only 27 percent households. The burden of water collection falls disproportionately on women. The participation of men in water fetching is very less across the country. The data collected by Indian Institute of Mass Communication Delhi IIM (1998) for Rajiv Gandhi National Drinking Water Mission shows that only 6 percent of men fetch water (ibid: 264). It is observed during the field survey that in most of the household females were carrying water in pots and oil jars (up to 50 litres of water in the single journey).

Further, it was observed that females were more interested and confident to respond than male regarding water related problems and water use at household. The content in box below clearly reflects the perspective of respondent regarding the women and water collection.

"Households having more number of female members can able to collect more water". Deepa Gadaily, Upper Sorok

"My neighbour collects more water than us because they are having more number of female members to collect water". Deepa Gadaily, Upper Sorok

Majority of water fetching households are low income groups. There is gender disparity in terms of collection of water. Collection of water is the responsibility of women in almost every household.

IV. 12. Rain Water Harvesting

The area of complex geological setting like Sikkim, where the layer of soil is moderately thin and the rocks are mostly exposed to the surface. In such topography the likelihood of soil erosion is very high especially in monsoon season due to heavy rainfall. The rainfall in this climatic zone is high especially in monsoon and winter remains dry which cause high water shortage during dry months. In such

circumstances collection and storing of rainwater from the roof and diversion of perennial springs and streams in storage structures (tanks) is the best alternative to cope with the water shortage problem as well as to prevent the soil erosion, as suggested by (Chand 2009). Rainwater harvesting is the collection and storage of rainfall and runoff from any catchment or watershed, either for domestic use or for irrigation. In a hilly area, where the development of extensive irrigation is not possible due to the topographical constraint; rainwater harvesting technique has proved to be a panacea (Mital 2009). Further, the success and sustainability of rainwater harvesting programme depends on the moderately large catchments and sufficient storage facilities available in the vicinity of the village. Rainwater harvesting practice would not only have a potential to make the livelihood of people more comfortable in water scarce region nonetheless it also endorses self – sufficiency and fosters an appreciation for water as a resource and also promotes water conservation. At the time of emergency or breakdown of public water supply system especially during a disaster like a landslide in hilly areas, the rainwater harvesting system provides an essential reserve of water.

Table 4.18: Household Practice Rainwater Harvesting

Total	No. HH Practice	No. of BPL HHs practice rainwater harvesting	No. of APL HHs practice rainwater harvesting
180	113 (62.8%)	74 (65.4%)	39 (34.6%)

Source**:** Field Survey, 2015 -2016

Collection and storing of rainwater is the another alternative adopted by the people to fulfil water requirement in water-scarce region. Rainwater harvesting is an old but useful approach to channel and use the rainwater in a productive manner (Ahmed, Mustafa and Khalid 2011). The rainwater harvesting methods which have a large potential to solve emerging water crises are known to the majority of households

in all the five surveyed villages. Three-fifth of the households are practicing rainwater collection and are using it for domestic purpose as well as for cattle. Household who do not have a large storage facility, have used 2 – 5 litre jar for collection and storing of water. Amongst the household practicing rainwater harvesting 65 percent are BPL household and only 35 are APL household. The number of BPL household is high because government has provided water harvesting tank to some of them. This rainwater harvesting tank is of varying capacity i.e. 5000 to 34000 litres which is located in the household premises. The tank is used for storing water so that it can be used in lean period. It was observed during field survey that most of rainwater harvesting tank and rubber tank were not in use especially in Rong village and Upper Kitam because of leakage and lack of maintenance. Further, a large number of households have been practicing roof top water harvesting especially in Upper Sorok and Upper Kitam. The households have used the bamboo pole to direct the water from the roof top and stored it in container on the ground with the help of jar and rubber pipe.

IV. 13. Summary

Water resource in Sikkim is available in the form of glacier, lakes, rivers, streams, springs, rainfall and underground water. Glaciers are the storehouse of water. It has given birth to the main river of Sikkim, the Teesta and the Rangeet. Likewise, the high altitude lakes of Sikkim also have feed many small rivers and streams. The lakes are not only the storehouse of water but it contributes indirectly to the revenue generation of the state through tourism.

The rivers and streams are very important sources of water which sustain the livelihood of people residing all the way from its source to mouth. Sikkim is drained by the main river Teesta and its tributaries. Originating from the north-eastern corner

of the state, it flows in north-west direction initially. After travelling a certain distance in north Sikkim, it flows towards south direction. From its source to mouth this river is joined by many tributaries from both left and right bank. The largest tributaries of the river Teesta is river Rangeet. The river Rangeet the west tributaries of Teesta meet near Melli Bazar in southern most part of South Sikkim. The Eastern tributaries of the Teesta River are larger in number than the western tributaries. But most of the western tributaries are originated from the glaciers hence they are larger in volume. The total catchment area of the river Teesta in Sikkim is 6,930 Sq. Km.

The main river which drains major part of South district is the river Rangeet and its tributaries. The major tributaries of the river Rangeet which drain the different part of South district are Rangbhang, Relli, Rothang and Lale. The river Rangeet is joined by number of small tributaries but is seasonal in nature. There are no perennial rivers which drain the central and northern part of district.

Likewise, water available in the form of rainfall is also very limited in South district of Sikkim. The analyses of rainfall data from 2005-2014 reveals that the district receives maximum rainfall from the months of April to September while remaining months it receives very less rainfall. The district records almost no rainfall for four months (November - February) for ten years. The highest rainfall recorded within ten years is 1089.1 mm. An annual average rainfall from 2005-14 shows that the lowest average annual rainfall was recorded in the year 2013 i.e. 88.3 mm and the highest average annual rainfall was recorded in the year 2007 i.e. 195.3. In 2013 the district receives only 88 mm of rainfall which is just higher than the state minimum rainfall 82mm.Overall, the South district receives very scanty rainfall.

According to the District Irrigation Plan of South Sikkim the total water available in South Sikkim is 0.01295 million cubic metre (MCL). Further, water

available in various water bodies including rainwater harvesting storage and surface store water is 0.01282 MCL and water available in perennial sources is 0.000116 MCL. Water available for irrigation is shown by gross irrigated area which is 1878 hectares. Furthermore, the present water demand of South Sikkim is 0.0256 MCL within which the domestic water demand and crop water demand is high. This shows that water available in South district is less.

Likewise, there is no large river to drain Namchi Block. Most of the streams which drain the block are non-perennial in nature and dry up in the lean period. Further, the rainfall data of three years shows that the Namchi received highest rainfall of 144 mm. The Namchi block did not receive rainfall in the months of November, December and January for consecutive three years. During these months the springs and springs get dry up leading to water shortage in both the rural and urban area. Further, it falls in rain shadow zone of Darjeeling Himalaya, hence it receives low rainfall.

According to the District Irrigation Plan, South Sikkim the surface stored water available in Namchi is 0.003 million cubic metres. The present water demand of Namchi is 0.00512 which is lower than district water demand. The domestic water demand is high in Namchi.

Source of Water

According to the Census of India tap, well, tube well, hand pumps, springs, rivers, tank and ponds are the different source of water for both rural and urban area in the State, District and Block level. Amongst these sources, tap water is an important source of water for both rural and urban household. The second important source of water is spring in both district and block level. In the rural area, only 25

percent household access water from treated source while in urban area, around 70 percent access water from treated source.

The data on water source availability reflects that 60 percent households in South Sikkim are having drinking water source available within premises. Further, within South Sikkim in urban areas more than three–fourth of households have access to drinking water within premises while in rural area only half of the households have access to water within premises. Likewise, in Namchi only half of rural household access water from within premises while in urban area more than three-fourth have water within premises. This means still large number of household in rural areas are spending the time to access water from the source located away from the home.

The field data demonstrate that in every surveyed village, water has been tapped from far distance sources and stored in community tank and from the tank household have individually connected the pipeline especially in Rong village while in Kitam, Upper Sorok village, Rural management and Development Department, Government of Sikkim has given the household connection. So the study suggest that Government Community Tank is the main source from where household access water. Likewise, the second important source is stream and spring. The other sources like well, tube well, bore well which is mentioned in the Census data are not found in the sample villages. The water connection types of household shows that majority of household have private connection from stream, springs and even from government community tank. Besides, individual connection, household also have water connection by RMDD and PHED, Government of Sikkim. These departments are responsible to provide water security to rural and urban household.

The study further shows that almost all the household have water connection at their household premises. Even the secondary data reflects the 100 percent water

connection in village but the ground fact is that supply is not regular, as the household who have water connection from community tank get water only one time a day for 30 minutes, once in two days for an hour, and some household gets once in a week. There is disparity in terms of duration of water supply which is mainly due to the differential rules of water management committee of respective village in such a situation there is no other alternative than storing water for two to three days for use. Every household stores in every possible container which varies from tank of 2000 litres to jar of 2-5 litres. Government of Sikkim have provided household water storage tank for BPL household.

Even with this limited stored water rural household are managing to use it for different purposes. The major purpose of use of water in rural area is for domestic, livestock, watering vegetable and flower. The use of water for the purpose of vegetable and flower is not regular. The frequency of use for vegetable is once in a week or once in fifteen days. Likewise, h use water for flower is once in two days. The regular use of water is only for the purpose of domestic and livestock. It was revealed during interaction that most of the household use waste water of kitchen for flower.

Due to the irregular and less duration of supply of water, the household are not getting adequate water for daily consumption. So to make water adequate for the daily use they collect water from different distance sources. On an average more than half of respondent household fetch water from outside sources. To collect water people travel half kilometre for single trip. Some of the household spend 3 hours a day to collect water. A majority of household makes two trips to collect sufficient water per day. It was revealed during interaction with the people that in the dry period the task of one to two persons from each of the household is to collect water. Further, from

majority of household it is the female member who fetches water. It is observed during field survey that females were carrying water in pots and jar (up to 50 litres of water in single journey) in bamboo basket from rugged topography especially in Upper Sorok and Upper Kitam village. Furthermore, it was revealed from field survey that women are responsible to collect water for household. In addition, during the course of interaction in Upper Sorok respondents said that the household who have more female member can collect more water. This is the one way the rural households of Namchi cope up with water shortage problem.

Another alternative which have been adopted by the rural household is rain water harvesting practice. The collection of rain water is the best practice amongst the respondent household. On an average 62 percent household collects rain water. For some of the BPL households RMDD, Government of Sikkim has provided water harvesting tank. In the Rong village almost all the households have rainwater harvesting tank provided by Government but many of which is not in use due to the leakage problem. It is noticed that only newly constructed tank is in use, while those tank which was constructed five years ago were not functional. In Upper Sorok, Upper Kitam village almost every household practice roof water harvesting by using their own techniques. The household have used bamboo pole to direct the water from the roof top and stored it in the container on the ground with the help of oil jar and rubber pipe. The collected rain water is use for domestic purpose as well as for cattle.

This is how the villagers are coping up with the water shortage problem. This chapter provides the idea about water availability status, access to water amongst household, different service provider and the adaptation of rural household. In the next chapter we will discuss about the water availability and management system in urban area of Namchi.

CHAPTER V

Availability, Access, Mode of Water Use and Management in Urban Areas of Namchi

The first section of this chapter deals with the analysis of the socio-economic characteristic of sample households of Namchi Municipal Council and the second section proposes to examine the water supply system and management system in Namchi Municipal Council by Water Security, Physical Health and Engineering Department, Government of Sikkim, Namchi. Further, the objective of this chapter is to examine the household level information on water access, connection types and number of connection, availability of supply, water charge, water fetching practices, availability of storage facility and management practices to know the ground reality of the water related issues in urban area.

V.1. Demographic Characteristics of Urban Area

The urban area of Namchi is administered under Namchi Municipal Council (NMC). The total geographical area of NMC is 7 km^2. It constitutes of seven municipal wards. The survey has been conducted in Upper Singithang ward as the area consists of both commercial and residential area. The below given analysis and interpretation will give the idea about the demographic characteristic of urban people of Namchi.

Table 5.1: Population of Namchi Town, 1991 - 2011

Year	Total Population
1991	630
2001	979
2011	12190

Source: Census of India, 1991, 2001, 2011

The urban population of Namchi is increasing in a rapid pace. Table 5.1 clearly reflects that population grew in every ten years. The factor for increase in population may be due to the delimitation of boundary of urban area, as those household who were in rural area now fall under municipal area. Likewise, migration may be the factors because mostly the people have migrated from rural area of Namchi for better facilities to urban area. As the present study was conducted in one of the municipal ward only but it was found that 30 percent of households had migrated from rural area.

Table 5.2: Population distribution of different Wards of Namchi Municipal Council, Census -2011

Name of the Ward	Population	Male	Female
Gangyap	2426	1208	1218
Dambudara	1225	639	586
Upper Ghurpisey	1182	588	594
Lower Ghurpisey	1910	953	957
Upper Boomtar	1505	766	739
Upper Singithang	2814	1450	1364
Purano Namchi	1128	562	566
Total	12190	6166	6024

Source: Census of India, 2011

Population Characteristics of Surveyed Household

The field data reveals that the total population of surveyed household of urban Namchi is 492 persons. Out of which the female constitute 53 percent and male constitute 47 percent. The number of female is higher than the male. The area experienced high sex ratio of 1120 female per 1000 male.

Table 5. 3: Distribution of Population by Age Group

Age group	No. of person	Percent	Male	Percent	Female	Percent	Sex ratio
0 – 14	82	16.7	42	18.1	40	15.4	952
15 -59	369	75.0	167	71.8	202	77.7	1209
Above 60	41	8.3	23	10.1	18	6.9	782
Total	492	100.0	232	100.0	260	100.0	1120

Source: Field Survey, 2015- 2016

The analysis of population by age group reveals that in the study area three-fourth of population are in the age group of 15 – 59, followed by the age group of 0 - 14. The sex ratio is highest in the age group of 15 – 59 i.e. 1209 female per 1000 male. On the other hand, sex ratio is very low in the age group of above 60 years. Amongst the male population, 71 percent are in the age group of 15 – 59 while 77 percent female are in this age group.

Table 5. 4: Distribution of Population by Education Level

Level of Education	No. of Person	Percent	Male	Percent	Female	Percent
Illiterate	65	13.2	24	10.3	41	15.8
Primary(I-V)	61	12.4	27	11.63	34	13.0
Upper Primary	88	17.9	42	18.10	46	17.7
Matriculation	72	14.6	33	14.22	39	15.0
High Secondary	78	15.8	32	13.79	46	17.7
Graduation	72	14.6	41	17.67	31	11.9
Post Graduation	24	4.9	12	5.17	12	4.6
Others	32	6.5	21	9.05	11	4.2
Total	492	100.0	232	100.0	260	100.0
Literacy Rate	87		89.65		84.2	

Source: Field Survey, 2015 -16

Out of the total surveyed population, around 87 percent are literate. Amongst the literates, 73 percent have educational qualification of Upper primary to Graduation

level and 12 percent have acquired primary education. Similarly, the number of person acquired post graduate degree is also considerably high. The overall literacy rate of surveyed area is 87 percent which is higher than state literacy rate. The male literacy rate is 89.65 percent and the female literacy rate is 84.2 percent. Amongst the illiterate population, female constitute higher number than male. Though the study shows that the male are more literate than female, the difference is only around 5 percent.

Amongst the respondent household majority of them are Hindu by religion. The Hindu household constitutes 59 percent while Buddhist constitutes 36 percent and Christian only 4 percent to the total respondent household.

Table 5.5: Distributions of Households by Social Groups

Social Group	No. of Households	Percentage
Schedule Caste	02	2.0
Schedule Tribe	35	35.0
Other Backward Class	54	54.0
General	09	9.0
Total	100	100.0

Source: Field Survey, 2015 - 2016

Similarly, as in rural area here Schedule Tribe includes (Bhutia, Lepcha, Limbo, Tamang, and Sherpa), Schedule Caste includes (Kami, Damai and Sarki), Other Backward Class includes (Rai, Gurung, Giri, Jogi, Thami, Sunwar, Bhujel, Bahun, Chettri, Newar, Manger, Mukhya) while general include people from other states. Amongst the surveyed household, more than half of the households are Other Backward Class, 35 percent are Schedule Tribe, and General constitutes 9 percent. The proportion of Schedule Caste households to the total households is very insignificant which only 2 percent is. This analysis indicates that the area constitutes of more Rai, Pradhan, Chettri, Bahun, Limbo, Tamang and Bhutia communities.

Table 5.6: Distribution of Households by Types of Residence

Types of Residence	No. of HH	Percentage
Migrant	29	29.0
Permanent Resident	71	71.0
Total	100	100.0

Source: Field Survey, 2015 -16

Data on types of residence have been collected to know about the impact of an migrant in the urban area of Namchi, especially on water related aspects. Most of the surveyed households are a permanent resident of Namchi town. The migrant household constitutes 30 percent in study area who have migrated from a rural area of the same district.

V.2. Socio-Economic Characteristics

Households are categorised on the basis of calories of intake into Below Poverty Line (BPL) and Above Poverty Line (APL). In rural area, households whose per day calories intake is 2100 they are considered as BPL and in urban area calories intake is 2400. In the urban area of Namchi, 96 percent of households are APL. The family structure of majority of urban household is nuclear, even-though 32 percent of household are still live in joint family.

House Types

The house types are categories into three types (pucca, semi – pucca and kutcha) on the basis of material used for building the house. The Pucca house is one whose walls, floor and roof are made of pucca materials like cement, concrete, stone, burnt bricks, corrugated iron sheet. A kutcha house is one whose wall, roof and floor are made of kutcha materials such as thatch, mud, low quality timber, grass, plastic sheet and other kutcha materials. A structure of houses which is built by using both pucca and kutcha materials is termed as semi – pucca. In the urban area, 92 percent of

the houses are pucca and only 2 percent are kutcha. This indicates that people have good living standard.

Table 5 .7: Distribution of Households by Households Asset

Items	Number of Households possess	Total Households
Radio	1	100
Tape recorder	77	100
TV	98	100
Computer	47	100
Laptop	55	100
Two-wheeler	0	100
Four Wheeler	60	100
LPG	100	100
Microwave	19	100
Refrigerator	91	100
Water Motor	15	100

Source: Field Survey, 2015 - 16

As compared to the rural households, urban people possess high value assets. Out of the total household, only 2 percent do not have a Television. More than half of the households owned Laptop, three-fifth of households possess four -wheeler. All the respondent households have LPG connection. Table 5.7 reveals that the living standard of urban people is good, as the majority of urban households possess very high value assets like TV, Laptop, Four Wheeler, Tap recorder, refrigerator etc.

Table 5.8: Distribution of Households by Land Holding

Land Holding size class (in hectare)		No. of Households
Landless		05
Marginal	(< 1 hac)	75
Small	(1 -2 hac)	12
Medium	(2 – 10 hac)	08
Total		95

Source: Field Survey, 2015-16

Unlike the rural household, the urban households possess a considerable amount of land. Table 5.8 reveals that 79 percent of households have a marginal land holding. Likewise, 12.6 percent have small holding i.e. 1-2 hector and 8.4 percent

have 2 to 10 hector of landholding. Some of the households have leased out their land for cultivation but the majority of them have not used it for any purpose.

Table 5.9: Distribution of Households by Monthly Income

Income Level	No. HHs
>10000	5
10001 -25000	25
25001 - 35000	15
35001 - 50000	15
50001 – 65000	17
65001 -Above	23
Total	100

Source: Field Survey, 2015 - 2016

Monthly incomes of urban household have calculated by summing up the income from various sources like income from the salary, business, other sources etc. Table 5.9 reveals that there is a high variation in monthly income amongst the household. Around 25 percent of households have monthly income of Rs 10000-25000, while 23 percent have an income of above Rs 65000 which is much high. Likewise, the households having monthly income between Rs 25000-50000 constitutes 30 percent. Furthermore, none of the households have monthly income below Rs 5000. This figure indicates that the economic condition of urban household is good.

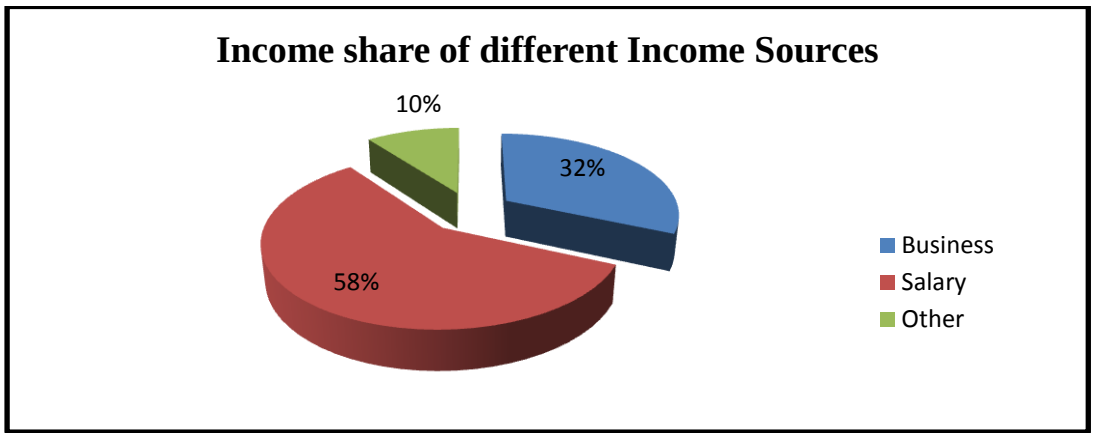


Figure. 5.1. Share of different Income Sources
Source: Field Survey, 2015 – 2016

Monthly salary from the government service is the first important income source of urban households followed by Business. Figure.5.1. reveals that more than half of the monthly income of urban households comes from the Government service. Similarly, second important income source is Business which constitutes 32 percent. Income from other sources (includes, painter, plumber, housemate, working in shops etc) contributes 10 percent to the average income of the households.

Table 5.10: Monthly Average Expenditure Share on Different Components

Expenditure Category	No. of HHs	Average expenditure	Expenditure Pattern (in Rs)							
			Food	Cloth	Health	Education	Ritual	Rent	Others[8]	Water
≤ 10000	10	7739	3480	450	100	610	585	1260	1160	94
10001-25000	62	16801	6331	1285	428	2778	1020	1586	3250	123
≥25001	28	32,064	9554	2475	1793	10281	1456	1679	4571	255

Source: Field Survey, 2015-2016

The share of expenditure in different components reveals that the expenditure on food is highest in all the expenditure category except > 25000 category. Amongst the households having monthly expenditure of < 10000 have higher expenditure on monthly rituals than on clothes. Similarly, the share of monthly expenditure on education is higher than on food and others of the household in the expenditure group of above Rs 25000. Likewise, in the expenditure category of 10001- 25000, expenditure share on food is highest followed by on others, education and rent. The share of expenditure on rent is almost same in three higher expenditure categories. The share of monthly expenditure on health is not much in two expenditure category.

[8] Expenditure on Others – It includes expenditure on travelling, mobile recharge, television bill, other daily expenses

In the same way the share of expenditure on cloth is also less. Monthly expenditure on water is the lowest as compared to expenditure on other components. This expenditure on water includes only the payment of monthly water charges not the expenditure on water connection and other expenditure for water.

Table 5.11: Classification of Working Population by Sector of Economy

Occupations	Total	In %	Male	In %	Female	In %
Primary	-	-	-	-	-	-
Secondary	18	8.6	13	10.5	5	5.9
Tertiary	190	91.4	111	89.5	79	94.1
Total working Population	208		124		84	
Total population	492		232		260	

Source: Field Survey, 2015 -16

Table 5.11 clearly shows that the majority of urban population are engaged in tertiary sector. Amongst the working population 91 percent are engaged in tertiary activities while only around 9 percent engaged in secondary sector. Further, amongst the male working population around 90 percent are engaged in tertiary sector while 10 percent engaged in secondary sector. Similarly, amongst the female working population 94 percent are engaged in tertiary sector. Overall, tertiary sector is the main occupation of the urban population. In both the secondary and tertiary sector male participation is higher than female. Within the non- working population, number of non-working female is higher than the male. Female are mainly engaged in household activities. Likewise, in available/seeking employment category number of female is higher than the male.

Table 5.11.i. Distribution of Population by Economic Activities

Occupations	Total	percent	Male	percent	Female	percent
Trade and Commerce	91	43.7	59	46.8	32	39.0
Services Sector	117	56.3	67	53.2	50	61.0
Total Working	208		126		82	
Total	492	100.0	232	100.0	260	100.0

Source: Field Survey, 2015 – 2016

The economic activity of the urban people is confined to trade and commerce and service sector. Amongst the working population 56 percent are engaged in service sector and around 44 percent in the trade and commerce. Within the male working population, 53 percent are engaged in service sector and 47 percent are engaged in trade and commerce. Similarly, amongst the female worker, 61 percent are in service sector and 39 are in trade and commerce.

The above discussion provides the idea that more than half of working population is engaged in service sector. The proportion of male worker is much higher than female worker (male constitute 61 percent and female constitute only 39 percent). Similarly, in both trade and commerce and in service sector proportion of male population is higher than the female.

The urban population of Namchi is increasing in very alarming rate. One factor for such high rate of growth is due to migration of people from rural area for better life opportunity. The total population of the surveyed area of urban Namchi is 492 in which number of female constitutes higher than the male. The sex ratio of the area is high. Further, majority of the population is at the age group of 15 -59 years. The sex ratio is also high at this age group while it is very low in the age group above 60 years. The population of the area is highly literate. The literacy rate is 87.0 percent which is much higher than sub-district and state literacy rate. The male are more

literate than female. The Other Backward Class household constitute highest to the total households followed by Schedule Tribe household. Around 30 percent of households are migrant in the area who have migrated from the rural area of the same block.

The socio-economic standard of people is good as almost all the houses are pucca houses like two to five storage building with better sanitation facility and well electrified. Further, the household owned a high value asset like refrigerator, vehicle, laptop computer, microwave etc. Likewise, the land holding pattern amongst the households is good. In addition, the monthly income of the majority of the household is above Rs.35000. The variation in the income is highly observed some of the household are earning more than a lakh per month. The salary is the main source of household monthly income because from every households one or two member draw income from government service. Further, 91 percent of population is engaged in tertiary activities.

Even having a better economic standard, the urban households are not able to access water in regular basis and for round a clock. As the water is limited in the area and the distribution and management of this is the responsibility of PHED. So in the next section of the chapter we will discuss about urban water management and distribution system and availability, access and mode of water use and management practices at household level.

V.3. Access to Drinking Water

Access to drinking water by the growing population is one of the major concerns in the world today. The Third World Water Forum organized by the World Water Council stated that demand for water is growing three times faster than the population by 2025. Further, the population lacking in water access would increase

from 450 million to about 3000 million (Kundu and Thakur 2006). It is stated that the problem of water deficiency has been recognized in India since the commencement of planning in the 1950s (ibid). So, in the year 1954 Government of India announced the National Water Scheme under Five Year Plans, and made specific provisions to assist state governments in its implementation through the Public Health and Engineering Departments, with the motive to make drinking water available to every household and to decentralized the water management system, since then water has been included in the state subject (Sara 2006).

The rapid growth of population, an extension of the boundary of urban areas and unequal distribution has created problem in the adequate availability of drinking water in towns and cities. Kundu and Thakur (2006) are of the opinion that the present deficiencies in the availability of water in urban areas are primarily because of management failure.

Namchi town is a fast growing town of Sikkim, where the high decadal growth of population is observed. In 1991 census, the total population of urban area was 630 while in 2001 it grew to 979. Further, in 2011 it has increased to 12,190. Such high increase in urban population may be due the migration of rural population, as this study found that within sample households of 100, 30 percent were found to have migrated from rural area for better facilities. Another factor is extension of urban boundary. Because of the high growth of population, the supply of water is becoming inadequate and unequal.

V.4. Water Supply System in Namchi Municipal Council

Earlier, Namchi town was sustained by springs (khola) namely, Dharay Khola, Bhanjang Khola, Damthang Dhara, Joubari. From these sources, water had been tapped and stored in a tank at Namchi by Public Welfare Department (PWD),

Government of Sikkim. The stored water had been supplied to the public through public stand post. There were no household water connections; only 6 to 7 stand post had been constructed by the Department at Namchi Bazaar from where people used to fetch water. Every household used to fetch water from stand post every day in the early morning for around 1- 2 hours as the Department used to open the distribution tap during this time only. People used to go at Tinzer Dhara and Bomtar Dhara for washing clothes, bathing and also to collect water. Gradually, these sources started drying up and could not fulfil the water requirements of the people. In addition to this increase in the population may also be the factor for causing a water shortage in an area. So, to fulfil the water needs of Namchi Town, Bermelli Khola was identified in the year 1985 as perennial source of water. In the same year, water supply scheme was sanctioned by the Government of Sikkim for the tapping of water from the Bermelli Khola to Namchi. The existing water supply system of Namchi came into operation in the year 1989. The source of present water supply is 46km from the Namchi town located at the altitude of 7,700 ft at Maenamla ridge under Ravangla Block. The water is tapped through gravity mode in 150mm diameter pipe from two sources viz Source I, source II at Bermelli khola. Bermelli Khola is the main source of water for urban and some part of rural Namchi that is termed as the lifeline of Namchi. In addition to this another source of water for Namchi town is the River Rangeet, the details of which will be discussed in the later paragraph. There is seasonal variation in the discharge of water from Bermelli. In the lean periods source I discharge is 2.75 Million Litre per Day M LD and in other than the lean periods is 82.74 MLD. Source II discharge is 1.25 MLD in the lean period and 45.70 in other than a lean period. The combined discharge of Source- I and Source – II in both lean season and in other than a lean season are 4.00 MLD, 128.44 respectively. The

average water supply from Bermelli is 1.50 MLD (Water Supply, Physical Health and Engineering Department, Government of Sikkim, Namchi).

From the source, water is tapped through 150mm diameter GI pipe with the capacity of 1.45 MLD water. The water is drawn from around 46 km distance and is firstly stored in reservoirs at Ghurpisey and then at Alley Gumpa reservoirs. The capacities of the reservoirs are 2 ML and 1 ML respectively and both the reservoirs are at ground level. The another source of water for Namchi town is the River Rangeet. From river Rangeet 1.5 MLD water is pumped and stored at Solophok reservoir and from Solophok to Alley Gumpa reservoir. The water supply from the River Rangeet started from 2011. However, the water treatment plant does exist but it is not functioning. Presently water is being supplied with chlorination without any proper treatment.

V.4.i. Distribution System

Namchi Municipal Area has been divided into six zones by the Water Security and Physical Health and Engineering Department for the convenient of water distribution. Each zone is fed with dedicated zonal tanks like, Forest tank, Loyela tank, Kazitar tank, Namchi Sr. Sec. School tank, etc. The stored water of Ghurpisey reservoir and Aley Gumpa reservoir is supplied to the zonal tank in various locations through 4 inch GI pipe. Water is distributed to the households through a network of the pipeline with the diameter range from 15mm to 32mm from the distribution chamber located in their respective zone. In each Zone, there is a fitter assigned by the department for the timely opening and closing of the valve and to check the leakage of the pipeline. The current average water supply of Namchi town is less than 1.50 Million Litres per Day (MLD). During lean season per capita, water supply goes down to 50 lpcd. (PHED, Government of Sikkim).

V.4.ii. Water Supply Tax in Urban Areas

Sikkim Water Supply and Water Tax Rules 1986 have been amended in the year 1990 and called as Sikkim Water Supply (Amendment) Rules 1990. Under this rules, every household that has water connection through PHE was charged on the basis of the number of Tap a household have connected. The rate charged for water use was different for domestic and commercial purposes which are presents in the table below.

Table 5.12: Water Charge for Water Supply at Namchi Municipal Council (2014)

Tap water in Ltrs/day	Domestic Rs. 5/ 1000 Ltrs	Commercial Rs. 10/ 1000 Ltrs
1 – 3 Taps	80	160
4 – 7 Taps	130	260
8 – 12 Taps	225	360

Source: PHE Department, Government of Sikkim, Namchi, South Sikkim

The household that had 1 to 3 number of tap connection was charged Rs 80 in case of domestic purpose and Rs 160 for commercial purpose. Similarly for 4 – 7 taps connections, Rs 130 is charged for domestic and Rs 260 for commercial and for 8 – 12 taps connection Rs 225 is charged for former and Rs 360 for latter or for domestic purpose Rs 5 / 1000ltrs of water and for commercial purpose Rs. 10 / 1000 ltrs. These rates prevailed till November 2014.

Again in the year 2014, Sikkim Water Supply Rule 1990 was amended and the new rules called Sikkim Water Supply (Amendment) Rule 2014, has come into force on 1st of December 2014. Since then, though the basis of water charge is same but the monthly rate of charge for every domestic and commercial water connection has increased. At present PHED is collecting Rs 90 from the household having 1 – 3 taps connection for domestic and Rs 190 for commercial. Likewise, for 4 – 7 taps

connection Rs 150 for domestic and Rs 190 for commercial and for 8 – 12 taps connection Rs 250 for domestic and Rs 390 for commercial. If the households connect more than 12 taps, for every extra (additional) tap, Rs 50 charged for domestic and Rs 100 for commercial. The charge for water use in Namchi Municipal Area is on non-volumetric basis since the volumetric metered is not introduced so far.

Table 5.12.i: Non Volumetric Water Tariff

Sl. No	No. Of Tap	Domestic	Commercial
Non volumetric			
1	1 – 3 taps	Rs, 90/-	180/-
2	4 – 7 taps	Rs. 150/-	290/-
3	8 – 12 taps	Rs, 250/-	390/-
4	Every extra tap excess 12 taps	Rs. 50/-	100/-

Source: Water Security, Physical Health and Engineering Department (PHED) Govt. of Sikkim, Namchi, South Sikkim

Under Sikkim Water Supply (Amendment) Rules 2014, it is also mentioned that water tax should collect on the basis of the volume of water use by households or on the volumetric basis to urban households. Same was also mentioned on Sikkim Water Supply Rules 1990 and the rate was for domestic use Rs 5/1000 litre of water and Rs 10/1000 ltr for commercial. But in the New rule, i.e. Sikkim Water Supply (Amendment) Rules 2014 the rate has changed, for first 20 KL Rs, 5/ KL for domestic and Rs 10/KL for commercial should be a charge. Similarly, from 20 to 40 KL of consumption Rs 8/KL and Rs. 13/KL, from 40 – 60 KL of consumption Rs 12/KL (domestic) and Rs 17/KL (Commercial) should be a charge. For every extra KL above 60, Rs 20/KL for both domestic and commercial should be a charge. This rule for water usages charge has not been introduced in Namchi till the date.

Table 5.12.ii: Volumetric Tariff per KL (1000 ltrs)

Sl. No	Volumetric	Domestic	Commercial
Volumetric			
1	First 20 KL	Rs, 5/ KL	10/KL
2	20– 40 KL	Rs. 8/ KL	13/ KL
3	40– 60 KL	Rs, 12/ KL	17/ KL
4	Every extra KL above 60 KL	Rs. 20/ KL	20 / KL

Source: Water security, Physical Health and Engineering Department (PHED) Govt. of Sikkim, Namchi, South Sikkim

According to new rules for water supply in Urban Namchi, every household who seek new water connection, firstly have to issue No Objection Certificate from the PHED office with the deposit of Rs. 60. The cost of application form for the new connection is Rs. 25 and for the new connection Rs. 600 for both the domestic and commercial. If the household wants to shift the supply point or connection point the fee for application form is Rs. 25 and connection fee is Rs. 300 and for a re-connection household is charged Rs. 100.

Table 5.13: Service Charges for Water Connection

Sl. No	Service	Fee
1	Cost of Application Form for New Connection	Rs. 25/-
2	New Connection Fee	Rs. 600/-
3	Shifting charge of supply point/connection point	Rs. 300/-
4	Re-Connection Fee	Rs. 100/-
5	Cost of Application form for shifting of connection point	Rs. 25/-
6	Fee for No Objection certificate	Rs. 60/-

Source: PHED, Namchi South Sikkim

Table 5.13.i.: Non-Volumetric Sewerage Charge

Sl. No	No. of Water Closet	Domestic	Commercial
Non volumetric			
1	1st Water Closet	Rs. 35/-	Rs. 35/-
2	Every additional Water Closet	Rs. 30/-	Rs. 30/-
3	Public Toilet	Rs. 150/-	Rs. 170/-

Source: PHED, Namchi South Sikkim

Similarly, Sikkim Sewerage and Sewage Disposal Rules, 1990 has amended and new rules called Sikkim Sewerage and Sewage Disposal (Amendment) Rules 2014 which has come into force on 1st December 2014. Where it has mentioned that for every domestic and commercial establishment, monthly levied for sewerage is on the non-volumetric basis. It is mentioned in the government notification that after the introduction of the volumetric tariff, the rate of sewerage charge would be on the basis of the volume of water use and the charge would be 60% of the water supply bill for both the domestic and commercial establishment.

To fulfil the growing water demand of Namchi Municipal Council (NMC), Water Security, PHED, Government of Sikkim have proposed a new water supply connection for Namchi town as existing water supply system of Namchi was established three decade ago and the targeted population was low. But the census 2011 reflects that Namchi is a fast growing town in Sikkim in terms of population, where decadal growth rate is very high. Further, the discharge of existing water source is also decreasing. The New additional water requirement has been projected considering both resident population and floating population of Namchi town. Under new water project, three new sources are identified near Bermelli and the designed water supply is 5.61 MLD of treated water to an intermediate population of 35206 and 10 % floating population. The designed period is initial 2016, intermediate 2031 and ultimate 2046 and the proposed level of water supply is 135 lpcd and 40 lpcd for floating population.

V.5. Water Availability and Access to Respondent Households

The field data reveals that almost all the respondent households have water supply from PHED. The connection of water from the Government tank to the

household is the responsibility of the individual household. The households are liable to pay water charge per month.

Table 5.14: Distribution of Households by Water Source Types

Source Types	No. of Households	Percent
Stream	7	6.0
Govt. Community Tank (PHE)	92	92.0
Fetching from Outside Source	1	1.0
Total	100	100.0

Source: Field Survey, 2015-2016

Water source types here means, the source of water from where a household gets water. The data on source types reveals that more than 90 percent of surveyed households have Government tank as the main source of drinking water. A very insignificant number of households have a stream and private tank as a source of drinking water. The households which are on the periphery of urban area have stream as the main source. There is one household whose water needs are met by fetching water located at a distance source.

Table 5.15: Distribution of Households by types of Connection

Water connection types	No. of Households	Percentage
PHED	92	91.0
Private connection (from Stream)	6	4.0
From other houses	1	1.0
Both PHE and RMDD	1	1.0
Total	99	99.0

Source: Field Survey, 2015 -2016

Note: RMDD- Rural Management and Development Department Govt. of Sikkim,
PHED – Physical health and Engineering Department, Govt. of Sikkim

A water connection type here means, water connection to the households through different modes for instance, the connection from a Government tank under the rules and regulation of urban water supply system and water connection privately

by the households from the streams. Almost all the surveyed households have water connection in their premises and are having a connection from PHED, Government of Sikkim, Namchi from Government tank. Some of the households located in the urban fringe have a stream as a main source of water and have connected water pipe privately without any support from others.

Table 5.15.i: Distribution of Households by Number of Water Connections

No. of connection	No. of Households	Percentage
No connection	01	1.0
Single	80	80.0
Double	17	17.0
Three	01	1.0
Four	01	1.0
Total	100	100.0

Source: Field Survey, 2015 -2016

The above data on number of water connection in the household reflects the disparity in water connection in the urban household. Household having single connection constitutes 80 percent while 17 percent have a double connection. This disparity exists due to the flexible rules for water connection. Some households who can afford to pay have even three to four connections. These households are high income group.

Table 5.16: Distribution of Households by Duration of Water Supply

Water Supply	No. of Households	Percentage
Regular[9]	6	6.18
Not Regular[10]	93	93.82
Total	99	100.00

Source: Field Survey, 2015 -2016

Out of the surveyed households, 99 percent have water connection at their premises. But the supply is regular to only 6 percent of households and remaining 94

[9] Regular supply here means the supply of water to the households daily one time
[10] Not regular supply means alternate day supply

percent do not have regular water supply. It is observed that households having regular water supply are middle and low income groups.

Table 5.16.i: Distribution of Households by Frequency of Water Supply

Frequency of Supply	No. of Household	Percentage
Daily Morning	8	8.1
Once in two days	87	87.8
Three days/week	3	3.1
Total	99	100.00

Source: Field Survey, 2015 -2016

V.6. Water Supply

Table 5.16.i reveals that four-fifth of the households get water once in the morning every alternate day. The water supply is more distressful for three households as they get water only for three days in a week and more so only for 30 minutes in each of the days of water supply. In contrast to this, there are certain privileged households who get water supply round the clock all through the week. There exist inequalities in water distribution system in the urban area of Namchi. The households who can afford to pay are having two to three connections with 24 hours supply. On the other hand, others are sustaining life by fetching water from a distance source. Most of the households are getting 30 minutes to 1 hour of water supply in every alternative day per week for one time at morning. Twenty-four hours of water supply in municipal taps is a dream of the majority of households in Indian town and cities (Shaban and Sharma 2007). This applies to Namchi also, as this study demonstrates that around 98 percent of households in Namchi Municipal area are not getting twenty four hours water supply.

Table 5.16.ii: Distribution of Households by Timing of Water Supply

Timing of Supply (minutes/ hours)	No. of Households	Percentage
15 minutes	08	8.08
30 minutes	30	30.30
1 hour	45	45.45
2 hours	12	12.12
24 hours	02	2.02
Total	99	100.00

Source: Field Survey, 2015 -2016

Table.5.16.ii. shows that amongst the households having a water supply, 39 percent get less than 30 minutes of water supply. Likewise, 45 percent get 1 hour of water supply and 12 percent get 2 hours of water supply. While there are two households who get water supply round a clock. The data clearly reflects the existence of an unequal supply of water to urban households. This inequality exist mostly due to the absence of work monitoring of the fitters by the Department, as fitters gives extra water to those households who give extra money to him.

Table 5.17: Distribution of Households by Number of Tap Connection

No. of tap connection	No. of HH	Percentage
1 – 5	57	58.76
6 – 10	28	28.86
11 – 15	11	11.34
16 – 25	1	1.03
Total	97	100.0

Source: Field Survey, 2015 -2016

It has been mentioned in the official notification of urban water supply system of Government of Sikkim that amount of water charge per month depends on the number of tap connection in the households. Hence, to examine the water charge system of the existing water supply department of Namchi, data has been collected on a number of tap connections per households. More than half of the households have 1-

5 taps and more than one-fourth of surveyed households have 6 – 10 taps. As per the official notification, households have to pay Rs. 90 per tap. But the data collected from the field suggest that such rule has not been followed or proper water charge has not been collected from the water user. Since the water charge is not being realized by the concerned Government department, shortage of fund may be affecting proper maintenance of water supply in the town.

Table 5.18: Monthly Water Bill Payment

Monthly bill in (Rs)	No. of Households	Percentage
Nil	11	11.0
80 – 90	59	59.0
100 – 200	19	19.0
201 – 800	11	11.0
Total	100	100.0

Source: Field Survey, 2015 -2016

Amongst the households more than half of households are paying only Rs 80 – 90 per month irrespective of a number of tap connections. Similarly, around 20 percent of households are paying Rs. 100 – 200 per month. There is no difference in water charges between domestic and commercial use of water in the town. Hoering (2012) believed that the higher water charges can bring about efficiency, investment and conservancy, which will also benefit the poor without access to water and sanitation. The department has constructed seven zonal tanks across the municipal area, and have appointed fitter in each zonal tank to open the valve in the morning. The fitters draw their monthly salary from the Government. The task of the fitter is to distribute water equally for equal duration of time to all the households. But during the field survey respondents reported that the fitter opens the valve for those households who have paid extra money.

"If I don't give extra money to the fitter, they will not give water". Sharala Rai, NMC. 12th Jan 2016

Table 5.19: Public Opinion on Quantity of Water Supply

Water Supply Status	No. of Households	Percentage
Sufficient	36	36.0
Not sufficient	64	64.0

Source: Field Survey, 2015-2016

It is very important to know about the public opinion on any kind of project in which they are directly involved as a consumer or as beneficiary as they are primary user and better known about the facts. Hence, the data has been collected on the same to examine the present water distribution system of PHED, Namchi. The above data exposes that more than three-fifth of households lack sufficient water supply for their daily consumption.

V.7. Water Purchasing Practice

In NMC, due to the irregular and insufficient quantity of water, people buy water to fulfill their water requirements. They buy water from the private source owner and from fitters. There is a person who has a perennial water source in his private land in Bomtar village located 4 km distance from town. This person supplies water to the household who demands.

The field data reveals that half of the households purchase water to fulfil their daily water requirements. Out of the households who buy water 30 percent households buy once in a week. Similarly, 62 percent households buy once a month and 6 percent households buy four times a week. People do purchase water, minimum 200 litres to maximum 4000 ltrs and the amount pay varies based on litres of water purchase. More than half of household purchase 600 -2000 litres of water. The rate of

water charge varies; on an average people pay Rs. 300 for 500 litres, Rs. 1500 for 2000 litres and Rs. 2500 for 4000 litres.

Table 5.20: Distribution of Households by Frequency of Water Purchase

Frequency of buy/year	No. of Households	Percentage
2 – 12 times	31	63.27
13 – 48 time	15	30.61
49 – 192 times	03	6. 12
Total	49	100.0
Litre of water buy		
Below 500 lt	14	28.57
600 – 2000lt	28	57.14
2000 – 4000lt	07	14.29
Total	49	100.0
Expenditure in buying water		
200 – 500	22	44.90
602- 1500	24	48.98
>1500	03	6.12
Total	49	100.0

Source: Field Survey, 2015 -2016

It was revealed from the interaction with the water supplier that from the private source he has stored water in a reservoir and from reservoir he supplies in his private water tanker in town on demand basis. This person sells water not on the basis of per litre of water but on the basis of distance covered. The water charge varies depends on the distance of location of household from the supplier residence. He takes only service charges (vehicle charge) based on distance covered. The supplier sells water to residential household, construction work and hotels. By selling water he runs truck, pays monthly salary to the truck driver and pays monthly insurance of truck. He does not charge for the water supplies to religious centre. So, in the seller's perspective it is a service charge they are collecting from the household who takes water from them. But from the buyers perspective it is the expenditure incurred to purchase litres of water. The above mention rate of water is the rate at which

household purchase water. Besides, the private supplier, fitters also sells water to the commercial establishment as well as other households.

Private supplier is taking advantage of water source and earning money by selling water in the Namchi town. The field data reveals that three- fourth of the households purchase water from private supplier while 18 percent household purchase from the fitter and 6 percent buy from a neighbour.

V. 8. Water Storage Facilities

All the respondent households in urban area have water storage facility. Unlike in rural area water storage facility in urban area is not provided by the Government. Every household have purchased water storage in their own capacities, as there is no other alternatives then storing water for use in non-supply days.

Table 5.21: Distribution of Households by Water Storage Types

Types of Storage	No. of HHs	Percentage
Rubber tank	91	91.0
Cemented Tank	2	2.0
Drum	5	5.0
Bucket	2	2.0
Total	100	100.0

Source: Field Survey, 2015 -2016

Table 5.21.i: Capacity of Storage Facilities

Capacity Litres in Ltrs	No. of HHs	Percentage
100 – 500	90	90.0
501 - 1500	2	2.0
1501- 2000	5	5.0
2001 - 5000	2	2.0
Above 5000	1	1.0
Total	100	100.0

Source: Field Survey, 2015 -2016

Every households have water storage facility in town varies from tank to jar. There is no other alternative then storing water in every possible container like a bottle, Jar, bucket, drum and tank because households get water in alternative days,

storing water for two days is necessary. A majority of the household have rubber tank to store water followed by drum. Table 5.21.i reflects that 90 percent of the households have water storage of 100 – 500 litres. Those household who afford to buy a large size container have above 5000 litres tank.

V. 9. Water Fetching Practice

Purchasing water is one of alternatives adopted by the household of NMC to cope up with water shortage problem while others are fetching water and collecting rainwater.

Table 5.22: Distribution of Households Who Fetch Water from Outside Source.

No. of Households Who fetch water	No. of HHs in which male member fetch water	No. of HHs in which female member fetch water
34	19 (55.9%)	15 (44.10%)

Source: Field Survey, 2015 -2016

So to make water available in non-supply days, people do fetch water. Amongst the respondent household 34 percent collect water from outside sources. Within which 71 percent fetch throughout the year and 29 percent fetch during lean period. The study demonstrates that from the nineteen household, male member collects water while from fifteen households female member collects water. It is very surprising to know that male outnumber the female participation in water collection, as most of the study suggests that female participation in water fetching is higher than male. Further, collection of water is considered as a responsibility of female of the household. This does not apply to Namchi town. The respondents reported that the reason for more male member in water collection is due to distance location of source. Further, it was observed that most of the tenants were gathered early morning in the source to collect water and for washing clothes.

Table 5.22.i: Distance Covered by Households to Fetch Water

Distance (in km)	No. of Households	Percentage
0.1 – 0.5	24	70.58
0.6 – 1.5	04	11.76
Above 2 km	06	17.64
Total	34	100.0

Source: Field Survey, 2015 -2016

Urban people fetch water from a different distance. There is one spring locally called *kazitar dhara* which is the nearest source, located in 0.5 km east from main Namchi Bazar. Others are located in the farther distance like *Singithang Dhara, Devithan Dhara and Bomtar Dhara* which is not located at a walking distance. These sources are in rural area. On an average 71 percent household collects water by covering the distance 0.5 km from Kazitar dhara. On the other hand, 17 percent of the households collect from above 2 km distance source. The respondents reported that rural people are not allowing them to collect water especially from the Devithan Dahara.

Table 5.22.ii: Frequency of Water Collection per day

Frequency of water fetching per day	No. of HHs	Percentage
1 time	11	32.35
2 times	16	47.05
3 - 6	07	20.58
Total HH	34	100.0

Source**:** Field Survey, 2015 -2016

Table 5.22.iii: Time Spent for Water Collection

Time Spent (minutes/ hours)	No. of HH	Percentage
Below 30 minutes	26	76.47
31– 1hour	04	11.76
1.1 – 2 hours	04	11.76
Total HH	34	100.0

Source**:** Field Survey, 2015 -2016

The data on frequency of water collection per day reveals that 47 percent household collects water two times per day and 32 percent collects one time per day. The household who collects water 3 to 6 times per day accounts 20 percent. The field data on time spent for water collection suggests that more than three- fourth of the households spent below 30 minutes daily to collect water. On the other hand 23 percent households spend 1 – 2 hours per day. Standing in queue early morning and evening and spending time more than two hours per day for water collection is very burdensome.

V.10. Purpose of Water Use

The urban households are using water for combination of purposes. Use of water for domestic, watering flower and commercial purposes are the major sector of usage. Commercial purpose means the water use to run hotels and fast-food.

Table 5.23: Purpose of Use of Water in Namchi Municipal Area

Mode of use of water	No. of Households	Percentage
Domestic and watering flower	45	45.0
Domestic, livestock and watering flower	03	3.0
Domestic, watering flower and Vegetable	03	3.0
Domestic, watering flower and Commercial	15	15.0
Only Domestic	07	7.0
Domestic and Commercial	27	27.0
Total	100	

Source: Field Survey, 2015 -2016

Here, data has been collected from the field on purpose of use of water to know different sectors of water consumption in the town. The use of water for the domestic purpose here includes use it for drinking, cooking and washing utensil, cleaning washing clothes and personal hygiene. The households who use water for vegetables and livestock are located in the outer fringe of the urban area and supply

dairy product to the town. However, the number of such households is very limited and are not using PHED water for this purpose. The above data reveals that 45 percent of household use water for domestic and watering flower. Likewise, 27 percent of household use water for domestic and commercial purpose. There are very few household who use water for vegetable and livestock. The household who use water only for domestic purpose accounts 3 percent, whereas households who use water for watering flower in garden accounts 65 percent. It is seen during a field survey that most of the households have flower pots and even small garden. Out of the total households 42 households use water for commercial purpose. Almost all the household use water combinedly for two to three purposes in the urban area

Table 5.24: Rain Water Harvesting Practice

Purposes of use of water	No. Households	Percentage
For flushing toilet and water flower	17	27.4
Livestock and watering vegetable	01	1.6
Washing clothes and cleaning house	40	64.6
Watering vegetable	01	1.6
Store in tank	01	1.6
Only watering flower	02	3.2
Total	62	

Source: Field Survey, 2015 -2016

Collection of rainwater is a good practice among the people of Namchi, as more than 62 percent of the surveyed household practice rainwater harvesting. Most of the houses in the town are designed with rainwater harvesting system. The residents have realized the water crises and have designed their houses with an underground tank. It was found during field survey that many houses have constructed underground tank of 15,000 to 25,000 litres, where they have collected

rainwater for the use during the dry period. Roof water harvesting is also practice by the household.

The collected rainwater is used for different purposes like use in flushing toilet, washing and cleaning, watering flower etc. The field data suggests that majority of the households are using rainwater for washing clothes and cleaning house. In addition, around 28 percent using it for flushing toilet and watering flowers. Those households who have large storage facility are able to store rainwater for future use.

V.11. Public Opinion in Water Supply System

To examine the present water supply of urban area the data has been collected from the field on level of public satisfaction on existing water supply system of NMC.

Table 5.25: Level of Public Satisfaction on Existing Water Supply in Namchi

Level of Satisfaction	No. Households	Percentage
Not strongly satisfied	63	63.00
Not satisfied	24	24.00
Satisfied	11	11.00
Strongly satisfied	02	02.00
Total	100	100.0

Source: Field Survey, 2015 -2016

The beneficiaries' opinion and satisfaction in any kind of implemented project enables us to examine the function of existing schemes. In this context, the above table 5.26 reflects that 87 percent of the surveyed household is not satisfied with existing water supply system of Namchi Municipal area. This clearly reveals that present water supply system is not able to provide an adequate amount of water to the urban household. To provide adequate water to the urban households PHED, Government of Sikkim has implemented new project for water supply in town and the project is under progress.

In NMC the water user charges have been collecting on the basis of number of tap connection at house not on volume of water use but as per the Sikkim Water Supply Act 1990 and 2014 water charges should collect on volumetric basis because of this reason unsystematic collection of water charge is prevailing in NMC. Similarly, leakage of water from pipeline is going undetached. To avoid such case installation of metre system is the need of the hour which can control the waste of water and can increase the fund for the maintenance work.

Table 5.26: Households Opinion for Installation of Meter System for Water Supply

Opinion	No. of households	In Percentage
Strongly Agree	70	70.0
Agree	19	19.0
Not agree	11	11.0
Total	100	100.0

Source: Field Survey, 2015 -2016

The data on public opinion on the installation of meter system for water supply has also been collected which revealed that 89 percent of the sample household is agreed for the setting up of meter system. They have further suggested that this system will bring the equality in water distribution system and also in water bill payment. It was observed during field survey that only a few high income group people were not agreed for the setup of meter system.

Overall it is seen in Namchi municipal water supply system that the water distribution system is commercialized. Further, the system is suffered from the leakage problem, illegal connection, illegal tapping from the way and flexible water connection rules as there is no limitation on the number of water connection. Amongst these problems, water lost in the distribution system is very high. The current study of

National Sample Survey estimated in the urban area 40 -50 percent of the water is lost in the distribution system (Shah 2016).

Though the present water supply system undergoes many setbacks still it has been providing water to every household in the area, where there is no presence of a single perennial stream. Day by day population is increasing and demand for water is also increasing simultaneously. So, to fulfil the growing water demands of urban households, Government have initiated new water project Bermelli II to provide a regular supply of water to every household. Under new water project, three new sources are identified near Bermelli. The designed water supply for this is 5.61 MLD of treated water to an intermediate population of 35206 population and 10 % floating population. The proposed level of water supply is 135 litre per capita per day (lpcd) and 40 lpcd for floating population (PHED, Government of Sikkim).

V.12. Summary

Unlike in rural area, water supply in urban area is provided by PHED, Government of Sikkim. Before operation of present water supply system, Namchi town was sustaining by the small streams like Dharay khola, Bhanjang khola, Dhamthang dhara. From these sources water was tapped by the Public Welfare Department, Government of Sikkim and stored in a tank. There were no individual household water connections. The distribution system was through public stand post. There was 6-7 stand post at Namchi Bazar from where people used to collect water. These stand post used to be opened by the Department at morning for 1-2 hours. Other sources from where people used to fetch water are Tinzer dhara and Boomtar Dhara. So people used to fulfill their water requirement by fetching water. Such system of distribution of water from stand post was there till 1989. Gradually these sources started drying up and could not fulfill the water demand of the growing

population. So to fulfill the water needs of the area and to provide individual connection to the household Bermelli Khola was identified in the year 1985 as perennial source water for Namchi town. In the same year Government of Sikkim sanctioned water supply project from Bermelli khola to Namchi. It took four years to complete the project. So the existing water supply system of Namchi came into operation in 1989. The source Bermelli is 46km far from Namchi located in Ravangla block within South Sikkim. From the Bermelli khola water is tapped through gravity mode in 150mm diameter pipe from two site named as source - I and source -II. The combined discharge of both the source I and II in lean period is 4 million litres per day and in other than lean period it is 128.4 MLD. On an average per day water discharge from the Bermelli is 1.50 MLD. Another water source for Namchi town is the river Rangeet which is operated recently in year 2011. From the Rangeet River water is pumped and stored in the reservoir above town. Similarly, water carried from Bermelli khola is stored in huge reservoir at Ghurpisey. There are three reservoirs in which water is stored for the distribution.

Distribution System: From the reservoir water is firstly distributed to the zonal tanks. The PHED have divided NMC into six zones to make it convenient to supply water. Further, in each zone the Department has constructed zonal tank. So, from the reservoir water is distributed to these zonal tanks and from zonal tank water is distributed to the individual household. The connection of water from the zonal tank to the household is the responsibility of individual household. In each zonal tank, Department has appointed fitter to open the valve and to look after the pipeline. The supply of water is not regular, which means department is supplying water to the household in ones in two days for one and an half hour.

The PHED collects water usages charge for each household. The monthly water bill is not based on volume of water use but on number of tap connection at household. For instance, for 1-3 tap connection Rs 90 for domestic use and Rs 190 for commercial. To have a water connection from PHED, household needs to apply with the deposit of Rs 700 in department. The Department is responsible for the maintenance of pipeline from the source to the zonal tank. So with this background, the field data has been collected on access, supply and mode of use of water to know ground reality of water issues in urban household.

The field data on household level information on water access and supply suggest that government tank is the main source of water of urban household and second important source is stream. Further, almost all the household have PHED connection. There are seven household who have water connection from stream. These household are located in the periphery of urban area. There is one household whose water needs are met by fetching water located at a distance sources. Though almost all the household have water connection but there is disparity on number of connection.

Some of the household have single connection while other high income groups have two to three connections. Such an unequal number of connection is because of the lenient rules of the Department for water connection. Moreover, every household have water connection at their premises but supply is not regular as they get water once in two days at morning. But there are eight privileged household who get water daily morning. On the other hand water supply is more distressful for three households as they get water only for three days in a week and more so only for 30 minutes in each of the days of water supply. Further, the duration of water supply varies from household to household, high income groups are getting more duration of

water than other income groups. This inequality in duration of water supply is because of bribe taking practice of fitter, as distribution of water to the household is the task of the fitter of respective zone. The rules for the collection of water charges have not been followed in the urban area. Department is not collecting water usage charge as per the Government notification. It is mentioned in the rules that the water charges should be based on the number of tap connection at household but such rules has not been followed. Majority of the respondent households pay Rs 90 irrespective of number of tap connection. Further, there is no difference in the charges between domestic and commercial use of the water in the town. Since, water charge as per the rules is not being realized by the concerned Government department, shortage of fund may be affecting proper maintenance of water supply in the town.

Due to irregular and less duration of water supply, household gets inadequate water. Further, the field data explore that three-fourth of respondent household reported that water supply provided by PHED is not sufficient for daily consumption. So to fulfill their daily water requirement, they buy water from the private supplier and some household fetch water from distance sources. There is a person who sells water to the town especially to hotels. This person has water source in his private land at Boomtar village. The village is located below Namchi town. Further, he sells water in his private tanker. A majority of household buy water once a month. But there are households who purchase water once in a week. Furthermore, more than half of households buy 600 - 2000 litres of water. The price of water depends on quantity of water purchased. For instance, Rs 300 for 500 litres of water likewise Rs 1500 for 2000 litres and Rs 2500 for 4000 litres of water. This water supplier runs his livelihood by selling water to the town.

To make water available in non-supply days, every household store water in every possible container. Around 90 percent of household store water in 500 litres container. Purchasing water from the private supplier is one alternative to deal with water problem while water fetching and rainwater harvesting are others.

Amongst the respondent 34 percent fetch water from outside sources. The frequency of per day water collection varies from one time to six times. A majority of household collects water two times a day by travelling half kilometre distance in single journey. Amongst the household who collects water majority of them spend 30 minutes for single trip. A very interesting fact is that number of male collects water is higher than female.

Further, collection of rainwater is a good practice in urban area. Most of the household are designed with rainwater harvesting system. The residents have realized the water crises and have designed their houses with an underground tank. It was found during field survey that many houses have constructed underground tank of 15,000 to 25,000 litres, where they have collected rainwater for the use during the dry period.

The collected rainwater is used for different purposes like use in flushing toilet, washing and cleaning, watering flower etc. The field data suggest that majority of the households are using rainwater for washing clothes and cleaning house.

The data on purpose of use of water in urban area suggests that domestic and watering flow is the major sector of use of water followed by commercial purpose. There are three household who use water for livestock and vegetable but this households are not using PHED water for this purpose as they are located in the periphery of urban area and hence are using stream water. There are seven household who use water only for domestic purpose.

To examine the present water supply system of Namchi town, the public opinion has collected from the field. The data generated from the field suggest that 87 percent of household are not satisfied with existing water supply system of PHED. The data on public opinion on the installation of meter system for water supply has also been collected which revealed that 89 percent of the sample household is agreed for the sitting up of meter system. They have further suggested that this system will bring the equality in water distribution system and also in water bill payment.

Though the present water supply system is suffered from the leakage problem, illegal connection, illegal tapping from the way and flexible water connection rules yet it have been providing water to household in urban area, where there is no presence of a single perennial stream. Day by day population is increasing and demand for water is also increasing simultaneously. So, to fulfil the growing water demands of urban households, Government have initiated new water project Bermelli II to provide a regular supply of water to every household. The proposed water supply in new project is 135 litres per capita per day.

Though the water management in the urban area is the responsibility of PHED, the urban households area actively participating in the water management work. Some of the household are managing by forming water committees. So in the next chapter we will discuss about community participation in water management in both the rural and urban area of Namchi. There are different formal and informal water committees formed in the rural area to manage water within the village. Further, the chapter will contain the description of the role of institutions in water allocation.

CHAPTER VI
Community Participation in Water Resource Management

This chapter deals with the role of community in water resource management. The first part of the chapter deals with the relevance of community participation. Further, the chapter contains a brief historical background of people's efforts in environmental conservation in general and water management in particular. Furthermore, the study tried to highlight the historical background of community participation in water resource management in Sikkim. Finally, the chapter explored how the local communities are participating in water management individually and through different formal and informal committees. This chapter also contains the role of different Government Department, Panchayat, and different committees in water management.

VI.1. Relevance of Community Participation

Community participation in water management is very important, as the communities are the primary user and know better about the available water at their locality. Many indigenous practices of water conservation and management with strong participation of community in construction, repairing and maintenance work would enable the development of a social bounding amongst the farmers and maintain the equal distribution of water. Participation of community in water management process generates a sense of responsibility and commitment towards the work. Furthermore, when a water resource is managed collectively then the responsibility of management in terms of cost is shared amongst them. Almost all the traditional water management system across India was practiced collectively by the water user. Such systems were found successful in terms of management and distribution of the resource. For instance, the traditional water conservation and management system of

Himachal Pradesh is found successful (Sharma and Kanwar, 2009). Similarly, many traditional water management system practices by the communities of north-eastern states of India such as Zabo, Dong are still relevant and is considered a sustainable system of water management. Further, the present study demonstrate that the local community who have jointly owned the source are able to manage the water resource properly and distributing it equally amongst themselves.

Community participation is significant in water management because it can solve the water related conflict in the society. Further, the participation of people is essential because it can give scope to the people to know about the importance of judicious use of water. Local community living near or within the resource area supposed to have greater knowledge and understanding of the resources and easily identify their constraints and opportunities (Agrawal and Angelson, 2009). The local community can contribute a lot to a sustainable use of the particular resource when they are made part of it. Community participation in water resource management can give scope to empower the local people and make them accountable to manage their available water resource. Isager, Theilade and Thomson (2004) argued that water resource management without genuine local participation has not only become a subject of failure but also resulted in conflict and violence. According to Agrawal and Angelsen 2009, excluding the local community in water project can intensify the illegal activities related to it. This suggests that community participation is very essential in water management.

Local communities play a vital role in conservation and management of natural resources like water and land. Since time immemorial people across the world are participating in resource management formally and informally. There are large number of evidences which reflects on the public efforts in environmental

conservation as a whole and water conservation and management in particular. A different level of planning has been made to incorporate the public in development related projects and resource conservation. The Dublin statement of World Water Forum (WWF) has clearly stated that public participation in water resource management and conservation is very essential. They are considered as a best user and manager of the resource. Further, Dublin statement had mentioned the importance of women participation in resource management. It stated that participation of women is essential for mainstream development.

VI.2. Historical Background of Community Participation in India

The importance of participation of local people in any developmental project was realized only after last half of 19th century when technology alone could not provide the sustainability to the implemented project. Before independence people used to depend on the traditional water sources like stream, springs and well and were responsible for management and maintenance of the same. They used to contribute as a labour and sometimes cash for water related work but after independence community participation declined (Mishra 2012). The government had implemented a number of water related scheme in rural India without the concern and willingness of local people. Hence, the project was not able to provide the benefits to the people and was not sustained for a longer period. The government had witnessed failure on the implemented scheme for more than a decade.

After such a failure the government, private institution and organization started involving the people and taking their consent for implementing the scheme directly related to them. Community participation is now considered as a panacea for sustainable resource management and conservation and to maintain sustainability on any project. Community participation is of two types, one where communities are

ordered or asked to take part irrespective of their willingness and another is where community participates willingly, forming committees among themselves and generating capital.

According to Mishra (2012) community participation and community management are two different aspects. The community participation means beneficiaries are involved in development activities, whereas community management refers to the capabilities and willingness of the beneficiaries to take charge and determine the nature of the development affecting them. Now, the simple meaning of community participation in management work either development related project or resource management is willingness and capabilities of people to involve and take responsibility to make a change in the progress of any development activities which directly affects them.

In India, community participation in water resource management started since long back mostly in southern states for irrigation purpose. Farmers in Karnataka, Andhara Pradesh, Orissa, and Maharashtra have formed a number of the formal and informal committee for the management of irrigation water. Community participation in drinking water management in the proper sense and in formal approach was started only after the implementation of Swajaldhara, a drinking water scheme, which was earlier known as Rajiv Gandhi Rural Drinking Water Scheme in the year 2003. In this project the complete planning, execution and management of the water supply scheme was done by rural people. This scheme was successfully implemented in 55 districts of India and could sustain for a longer period of time. It is considered that the reason behind successful implementation and sustainability of this scheme is the involvement of the rural community in the project.

Today, the traditional way of community participation in resource management and conservation like water, forest is getting revived. With the increasing population, the pressures on available resources are also increasing day by day. Water, a life sustaining resource is getting scarce day by day due to increasing demand varies from domestic to other sector of development. The earlier implemented projects for water supply and allocation are not fulfilling the water demands in both rural and urban area. Hence, people today are not waiting for the government fund and projects to get benefit from it especially in rural area. Literature on community participation in water management clearly reflects the evidences from across the world and country particular that rural people are managing their available water resource by generating social capital, like labour, money and construction material. It has been proved by local community that they know better about their available resource and have ability to manage it. Local communities possess detail indigenous knowledge about water resource management, the way they need water for daily activities and the way they use. Further, they can analyse the historical change that occurred related to water access and use. Local communities can effectively monitor and detect the person violate the rule set for the water connection and use in their locality. Local communities possess strong incentives and willingness to struggle for the access to water also they are able to solve the conflict and dispute related to water resource management (Bruns, 2008). There is potential to develop creative and realistic options for water resource management, particularly at local geographical scales, involving water users (Carter, Day, Guthrie, and Daphne, 2011). Further, they have mentioned that traditional water management practice should use as a foundation for further development of water resource management strategy. The study of Day (2009) demonstrated how the rural people of Darfu with their indigenous knowledge

could be able to monitor underground water level with the help of the rope. In addition by making brick lined wells they would be able to compare water levels between dry and rainy season.

Natural resources like water, land and forest cannot be managed properly without involving rural communities. Community natural resource management system has existed in the past history. There are number of well known participatory efforts of people in resource management such as Van Panchayat of Kumaon, Pani Panchayat of Maharashtra, Sukho Majri experiment in Haryana, JFM committee of Orissa, Chipko in Haryana etc (Narwani, 2005). In Andhra Pradesh people do involve in tank management since British regime, the study highlighted that informal committee has been formed by villager for the clearing and maintaining the channels. Further, committee monitors the inflow of water into the tank and collectively decides the timing to open the sluice. The farmer committee has appointed water manager to attend to distribution beneath the sluice, he is paid in kind and cash. Those who do not attend for maintenance work are charged Rs. 25 per hectare and labourers are hired to do the cleaning since, the tank water is used for irrigation purpose (ibid). Similarly, in West Bengal tube well irrigation system became successful to provide equal benefit to user. Earlier it was under irrigation department and was not successful to provide equal benefit to all communities but after handing the system to beneficiary by forming committees, community management has reduced incidence of theft, developed a sense of ownership among farmers, water rates are economical, optimum utilization of installed capacity, local operator got employment and uses water effectively, cost of operation and maintenance is reduced (ibid). In the same way, Were, Swallow and Roy (2006) through their empirical study on water, women and social organization found that people have taken initiatives to implement the water

project in village by forming different committee. Both men and women actively took part for the management of water project to bring the water in the village. Initially women were excluded from the committee and they felt marginalized in the project and had formed a separate women group. This group raised fund by engaged in the informal labour and the money earned from that was invested in planting tea seedling which was later sold. Some amount of money earned from selling seedling was used by each member for repaying of loans which had been obtained by men for the construction of reservoir tank. They have suggested that collective action is seen to achieve greater impact when the division of labour is characterized by reciprocity, when men and women negotiate their rights deliberately and undertake activities complementing each other and when trust and social cohesion is strong between men and women. Similarly in the another village in same district women's groups have contributed from the monthly earning of Rs 500 towards the spring protection and purchase of pipes. These are some of the successful stories of community management of water resource.

VI.3. Community Participation in Water Management in Sikkim

Community participation here means the participation of local community inhabited in a particular area irrespective of social hierarchy. In the rural areas of Sikkim, Rural Management and Development Department, Government of Sikkim is a responsible department for providing clean and adequate water to rural households. All water supply related scheme for rural areas is implemented through this department like household water connection, distribution of rainwater harvesting tank, roof water harvesting, rejuvenation of pond, lakes, spring, distribution of tank, tapping water from far distance sources and storing it in huge volume tank to make available for people.

People in Sikkim used to manage their available water resource through traditional knowledge prior to the implementation of water supply schemes planned and implemented by government of Sikkim. Till the late 1975, every household in the rural area of Sikkim used to collect water from different sources like pond, stream, spring and river. They use to collect water in vessel made of bamboo. Some of the households used to use the bamboo pole to carry water from the source till house wherever the topography is suitable. Mostly, people used to use the bamboo pole to tap from the source to make it possible to collect for domestic purpose. Because of the economic condition and lack of the modern technique of using rubber or iron pipe to tap water from the source, availability of water within premises was a dream for the people. For the agriculture purpose farmers used to carve out the hill slopes along the gradient of gravity and divert the stream water into the canal to the agriculture fields without any external support. Such canal is locally called (Kulo). This way the local community used to participate in water management.

Later, with the government initiatives during the 1977s, water supply scheme had been implemented in those villages which were facing acute water shortage based on the public demand. The water was tapped through rubber pipe from the source and stored in the tank constructed with the stone and cement, wherever it is suitable to distribute to a cluster of the household. There was no individual water connections to the household, only one stand post was provided to 5 -6 households from where the households used to collect water. For the minor maintenance of water tank and pipeline, Panchayat used to provide fund from their office and for the major maintenance work, a fund used to be provided by the concerned department. The water supply systems which were installed during this time were all demand driven not supply oriented. The demand for water supply used to put forward from the

village through Panchayat to the concerned department. Though the people used to participate as paid labour for the construction of water infrastructure but they used to work in full dedication and with the sense of responsibility.

The water supply through this process is also not supplied equally to all so, to cope up with water shortage problem, those households who were economically sound, they used to buy rubber pipe and tapped water collectively from distance source. On the other hand those who were not able to buy they used to connect water from those households with the help of bamboo pole. With such kind of initiative, in some of the village a cluster of 3-4 households started tapping water collectively in cost sharing basis. In this way helping each other to access water, people developed a sense of community participation.

This is how people started coming together to manage the available water in the villages. Further, to perform rituals in the water source is an old age practice in Sikkim. People used to consider water sources a sacred place and they used to clean the source and preformed ritual collectively.

After the 1980s, Government of Sikkim started supplying water in the iron pipe and the water tanks were constructed RCC. The distribution systems of water to the households were similar as before. From the mid of the 80s, a massive rural drinking water supply was initiated and most of the households were covered with the water connection within premises for domestic purpose. For the irrigation purpose, many minor irrigation projects were implemented through Department of Irrigation, Government of Sikkim. In the implementation phase of the project, communities used to participate as a paid labourer. After 1990 those households which were left to cover by the water connection were connected.

Today due to increasing population those water supply projects which were implemented earlier are not able to provide adequate water to the people, leading to people the shortage of water. Hence, rural people have again started managing their water resource collectively. A cluster of households in every village has taken the responsibility of maintenance of water sources and management of water resource in a very systematic process. Villagers have formed a number of informal committees to manage available water. They are generating capital and material for the construction of water infrastructure and distributing the available water amongst themselves in a very systematic way. They are actively participating in water development and management work in their villages. Besides, these days Government has given the platform to the people to discuss and raise their voice through Gram Sabah about the water related issues and the requirement of a water project in the village.

In addition to this, under the scheme of National Rural Drinking Water Supply Projects (NRDWP), the Government has initiated the augmentation of water infrastructure in all the four district of the state. Similarly, a number of water security schemes have been implemented in the dry areas, such as distribution of rainwater harvesting tank, roof water harvesting technique, distribution of water tank to Schedule Tribe and Scheduled Caste households, construction of pits and trenches in the upper catchment area of water source to recharge the underground aquifer and to rejuvenate the springs, rejuvenation of dry lakes, etc. At village level, village water and sanitation committee have been formed under the guidelines of National Rural Drinking Water Programme. The water infrastructure which is installed by the Government department has been handed over to this committee for the management and maintenance. Further, the department has given the responsibility of collecting of water usage charges to the Panchayat. The panchayat use the collected fund for the

minor maintenance of the tank and pipeline. Though in Sikkim communities are participating in water management since time immemorial the willingness of taking responsibility of management is increasing day by day. As they have realized the importance of water and have started taking more responsibility for the management of the available water and are willing to pay for water. Further, they are able to solve water related conflicts within the village.

To know about the community participation in water resource management in the study area, and their role in management aspects, data has been collected on participation in water management, with a focus on gender specific. Data on number of days and hours people engage in water management has also been collected to know the level of participation. The first section of the chapter deals with the community participation in water management in rural Namchi and the second section present community participation in water management in urban area.

VI.4. Community Participation in Water Management in Rural Areas of Namchi

The participation here means involvement of people in any water management related work (which includes, maintenance of source, water watchman, plumber, fitter, maintenance of pipeline, distribution, conducting a meeting, a plantation in the source area, collection of the fund for maintenance, water fetching etc). On an average, 96 percent of the surveyed households are participating in water management in various capacities.

The analysis of gender participation reveals that male participation is higher than the participation of female in water management aspects. On an average, male from 84 percent of households and female from 16 percent of households participate in water management. The reason for the higher male participant is that the locations

of water sources are very far from the village and have to go through rugged topography and cliff which requires rigorous physical work.

Table 6.1: Distribution of Participant by Age Group

Age Group of Participant (in years)	No. of HH	Percentage
Below 18	7	4.04
19 - 29	23	13.29
30 -39	37	21.38
40 - 49	48	27.74
50 - 59	27	15.60
Above 60	31	17.91
Total	173	100.0

Source: Field Survey, 2015 -2016

Three – fourth of the participant in water resource management are youth, within the age group of (19 – 59). Youth participant is essential in terms of the workforce as well as for new ideas. Participation of people above the age group of 60 years is considerably high i.e. 17 percent. In the matter of conservation, preservation and management of resource old aged people believed to have a better experience and good traditional knowledge. This age group people play a role as an advisor to the other people.

Table 6.2: Educational Level of Participant

Education Level of Participants	No. of Households	Percentage
Illiterate	21	12.13
Primary	52	30.0
Upper Primary	42	24.27
Matriculation	31	17.92
High Secondary	17	9.8
Graduation	9	5.2
Post – Graduation	1	0.6

Source: Field Survey, 2015 -2016

Table 6.2 reveals that amongst the participants, 87 percent are literate and 12 percent are illiterate. Majority of participant have upper primary level education. The field data clearly reflects that there is an inverse relationship between the level of education and participation in water management work i.e. higher the level of education of people lower the participation.

Table 6.3: Distribution of Household by Mode of Participation

Mode of Participation	No. of Households	Percentage
Individually	124	71.67
Government Fitter	4	2.31
Committee Member	28	16.18
Water User Committee (Household who access water from the same source)	13	7.51
Government and Private fitter	4	2.31
Total	173	100.0

Source: Field Survey, 2015 -2016

Rural people of Namchi have put great efforts to manage their water requirements. A large majority of household participate individually[11]. While on an average 23 percent have participated by forming different committees such as water harvesting committees (includes those households who are accessing water from government community tank and have formally joined the group), water user households (includes households who have access water from the same source by taking source in leased or by collecting fund for maintenance work and for construction of tank. They have given their time on water collection and management. Villagers have managed to access water by generating social capital in the form of money, construction material, labour to build tank and for the maintenance work. In

[11] Individually means the household who participate in water management in the own efforts, without associating with other household or without support of any agency.

every village, there is a person nominated by Panchayat to look after the water pipeline maintenance work and designated him as barefoot engineer/fitter.

Overall it is found that participation of the community in water management work is very high in Namchi. Further, most of the participants are an adult (19 – 59 years old) and having low education qualification.

Table 6.4: Number of Days People Participate in Water Management Work per Month

No. of Day/ Month	No. of Households	Percentage
Nil	7	3.9
1 – 5	93	53.75
6 – 10	30	17.34
11 – 15	24	13.87
16 – 20	8	4.62
21 – 25	1	0.57
26 – 30	17	9.82
Total	173	100.0

Source: Field Survey, 2015 -2016

To know about the community participation in water resource management, datas have been collected particularly about the number of days and hours per month people engage in water management works. Participation here includes all types of participation as a labour, individual attended meeting, professional, and participation in their private water management. The above data reveals that 96 percent of the total households have participated in water management work. Out of which half of the households are participating five days in a month. Similarly, 35 percent of households are participating 10 – 25 days per month and households who participate almost every day for water management accounts 9 percent to the total participant. An average number of day household participate in water management per month is 9 days. The

low and middle income groups are participating higher than other income group people in water management..

Table 6.5: Time Spent for Water Management Work on the day they Participate

Time (in Hours)	No. of Households	Percentage
≤ 1	40	23.1
1 – 2	38	21.9
2 – 3	24	13.9
3- 4	25	14.4
4 -5	7	4.04
5 -6	16	9.2
6 -7	3	1.7
7 -8	20	11.6
Total	173	100.0

Source: Field Survey 2015-16

The time spent by the people for water management work is also one of the important variables to find out the level of community participation. The time spend means, the time spend by households on the day they participate in water management work. Table 6.5 reveals that 23.1 percent households spent less than 1 hour for water management work, 22 percent spent one to two hours. Households who spent two to four hours constitute 28 percent. Likewise, 13 percent households spent four to six hours time on the day they participate. There are 20 households who spent even seven to eight hours time for water management. In almost all the villages the water has been carried from the distant sources (approximately 5 to 10 kilometre). So at the time of damages of pipeline villagers spent around 7 - 8 hours a day for the maintenance work. 6295070453

The above interpretation suggests that the participation of rural communities in water management is very high. Spending more than four hours of time for resource management reflects the positive attitude of the people towards the resource management and conservation. It is observed during the field survey that

people gathered in the tank area to check the linkages and for other maintenance work.

Table 6.6: Monthly Expenses in Water

Monthly Expenditure (in Rs)	No. of Households	Percentage
Below 20	113	62.7
21 – 40	28	15.6
41 – 60	16	8.9
61 – 80	5	2.8
81 – 100	16	8.9
Above 100	2	1.1
Total	180	100

Source: Field Survey, 2015-2016

Villagers have formed various committees for the management of water resource. Out of the total five surveyed villages, in three villages viz Rong, Kitam, Upper Sorok, the Panchayat do collect monthly water charge compulsorily from all the households. The water charge varies from Rs 10 to 30. Those households who do not have government water connections (RMDD) also pay the monthly water bill. Besides this, the existing various water management committee do collect monthly water charge, for example in Rong village, households having water connection from water harvesting tank are paying monthly Rs 25 and a joining fee is Rs 500. If any household fails to go for maintenance work they have to pay a labour charge for that day. Similarly, the water user committees are collecting monthly amount from every member households which varies from committee to committee (rang from Rs 25 – Rs 100). The collected amount is used to buy material for the maintenance of pipeline and water tank. The above table 6.6 reflects the monthly expenditure of household on water which excludes expenditure on buying of pipe, tap, construction of tanks, connection expenditure and expenditure on motor etc. Though around 63 percent

households spends Rs 20 as water charge per month there are households who spends Rs 100 and above.

> *"We are collecting a monthly fee of Rs 30 as water charge and for new connection joining fee is Rs 300. Those households who are not able to participate in the maintenance work or not able to go to source on the date fixed by the committee is fined of Rs 200". Meera Subba, Panchayat member, Upper Kitam Ward.*
>
> *"We have collectively built a tank to reserve water for fire protection in the village because we do not have adequate water in the household to use at the time of emergency". Bhagat Ram Rai, Rong*

> *'If the member household is not able to go for the maintenance work, they are fined of Rs 150 per household in "Water Harvesting Committee".' Job Gurung Member of Committee, Rong Village*

VI.5. Water Management Committee formed in Rural Areas of Namchi

The rural communities of Namchi are managing their water resources within a village by forming different formal and informal committees. The data reveals that majority of the surveyed households are managing water individually yet there are water committees who have taken the responsibility of management of water resource in the village. The details of the water management committees are presented in table below.

Table 6.7: Water Management Committees Formed in Rural Namchi

Name of Water Management Committee	No. of HH	In Percentage
Water Harvesting Committee	10	22.2
Water User Committee	28	62.2
Village Water and Sanitation committee (VWSC)	6	13.3
Jal Kranti Committee and VWSC	1	2.2
Total	45	100.0

Source: Field Survey, 2015 -2016

Table 6.7 reveals that only 25 percent of surveyed households are the member of water management committee. This is because, in three surveyed village viz Singithang and Upper Sorok and Lower Phalidara, water management committees are not seen as in Rong village and in Kitam Village. In these three villages, households have privately managed water. The Village Water and Sanitation Committee have been formed in all the Gram Panchayat Unit. In this committee the Panchayat president is a Chairman, all panchayat members as member and technical person like Junior Engineer, Assistant Engineer and Barefoot engineer (nominated by committee) and two to three senior person of the village. So, the committee constitutes of 7-8 members only. There is one VWSC in one GPU and a GPU consist of many villages. There is no possibility to include all the households hence the participation of the community in this committee is less. People in Singithang, Upper Sorok and Lower Phalidara reported that they are not aware of this committee. Only some households in Rong and Upper Kitam have an idea behind forming of this committee and are the committee member. Water harvesting committee is found in both Upper Kitam and Rong Village. In both the village, those households tapped water from water harvesting tank are the member of the committee. More than 15 households in Upper Kitam village are located above the tank and are not the member of this committee. Similarly, a cluster of 4 – 6 households mostly of same caste or close relatives in all five surveyed village are accessing water from the same source and termed it as water user household.

Villagers in rural Namchi have formed various water management committees for the management of available water resource in the village and also by carrying from a farther distance.

VI.5.i. Village Water and Sanitation Committee (VWSC) exists in every surveyed village, formally through Panchayat office. This committee has been formed under the guidelines of Central Government. Where Panchayat president is the Chairman of the committee, Panchayat members are members, Junior Engineer (JE) and Assistant Engineer (AE), one trained person is designated as a barefoot engineer a (field worker) and two or three senior people of the village. Altogether committee constitutes of 6 -8 persons. The task of barefoot engineer (fitter) is to open a water distribution valve, maintenance work and to collect the water charge from every household. If the household wants to connect water from the government community tank than they have to apply in Panchayat office. This committee looks after the household level water related problems. Further, the committee is actively involved in the planning and implementation of water related projects in the villages. Besides this committee, there are other committees like:

VI.5.ii. Water Harvesting Committee

This committee is formed by a villager to maintain equal distribution of water from the Harvesting Tank. Since, water harvesting tank is constructed by RMDD Government of Sikkim with the labour and material support from the villagers for water security in the village. This committee is formed in two villages viz Rong and Upper Kitam. The structure, pattern and function of committee varies from village to village. The number of water management committee has been formed in rural Namchi, especially in Rong village and Upper Kitam. Rong village under Rong Bull Gram Panchayat Unit, have started forming water management committee since the year 2000, viz Water Harvesting Committee, Village Water and Sanitation Committee, Water User Committee. This village was the first village to initiate such activities. Earlier the people of Rong used to fulfil their water requirement mostly by

fetching water from a distance source. They could get household water connection only when the Horticulture Department constructed water tank in the village with the motive to provide water for horticulture purpose. In Rong village, Department of Horticulture with the support of villager have constructed water tank to supply water for growing horticulture crops in the year 2000 and the tank has been filled by tapping water from the perennial stream at Singtam village, 5 km far from Rong through the pipeline. Later, due to the drinking water shortage in the village, villagers with the permission from the same department use it for the drinking purpose. So, to avoid the conflicts and to maintain equal water distribution from the tank, villagers had formed a committee with the consent of Panchayat and named it as Water Harvesting Committee.

Function of Committee:

To form this committee, firstly villagers organize a meeting to decide those household who wants to take water connection from the harvesting tank. Subsequently, in the next meeting they created different post and nominate one member as president, one vice- president, secretary, treasurer, and water watchman (fitter). The motive behind the formation of this hierarchy amongst the member is to run the committee smoothly and in a formal manner. In the same meeting they decide the joining fee and the monthly collection of money from the households who take water connection from harvesting tank.

After this decision, the household taking water connection from the tank paying a joining fee of Rs 500 and would be a member of the committee. The treasurer collects Rs. 30 per month or annually Rs.370 from every member household. The collected amount is use to pay monthly salary of water watchman and maintenance work. After that the remaining amount is deposit in the post office for

future use. In addition to this the committee allows the member to take the money from the post office for their personal work with the consent of the committee members. Further, those who take money are liable to pay a rate of interest fixed by the committee.

Furthermore, to maintain the equal distribution of water amongst the household, the committee has fixed the timing of locking and unlocking of the valve and the responsibility of which is given to the water watchman. The water watchman opens the valve every morning at around 7 o'clock for 1 hour to every household. For the maintenance work and to check the pipeline, the committee fixed the date and calls the member household to participate. If the household fail to go for the work they pay Rs 150 as a fine. If the monthly collected amount is not sufficient for maintenance work then treasurer collects extra money from the each member household. This committee conduct meeting twice a year to discuss account details and other water related matters.

Similarly, in Upper Kitam village RMDD of Government of Sikkim tapped water from the Mikkhola stream and stored in a tank of 10000 litres at upper Kitam. Households accessing water from this tank have formed a committee in which Panchayat members are also included. Households accessing water from the tank have to put up an application in Panchayat office with the joining fee of Rs 300. The committee collects Rs. 30 from member households as monthly water charge and is given to the Panchayat office. This committee functions with the direction of Panchayat. The committee has nominated one fitter/ barefoot engineer to collect water usage charge and to look after water pipeline condition. In case of major damage, this person informs Panchayat. The panchayat arrange a meeting within a week with the

member household and fixed the day for repairing work. If the household fail to go for repairing work is liable to pay Rs 200 as a fine.

Further, to open the main distribution valve, member household have nominated one person in a monthly payment basis. This person gives siren before he unlocks the valve. To maintain equal distribution of water, the distribution valve is open for 30 minutes every morning to member household. It has been observed during the field survey that the size of the pipe connected to member household from tank was same. The very interesting fact is that to avoid the thief and unequal distribution of water, the main distribution valve is covered by cemented wall and wooden matter and kept in lock. The water watchman is only the authorized person to lock and unlock the system.

> *"We are collecting a monthly fee of Rs 30 as water charge and for new connection joining fee is Rs 300. Those households who are not able to participate in the maintenance work or not able to go to the source on the date fixed by the committee is fined of Rs 200". Meera Subba, Panchayat member, Upper Kitam Ward.*

VI.5.iii. Water User Committee

This committee is small informal body constitutes of 4 – 6 households in the village. The committee has been formed in all five surveyed villages. There are number of water user committees formed in the study area varying from 1 – 5 committees. A group of households who are accessing water from the one source have formed committee which is termed as water user committee. The member of this committee also collects Rs 20 – 45 per month and use the amount to construction tank and maintenance work.

One of the water user committees in Rong village is constitutes of 13 households and is functioning in a formal manner. Initially the committee has nominated one senior man as treasurer to collect a monthly water usage charge from every member households. But at present that person has given this responsibility to a lady with the viewed that women can manage the fund better than men. One water watchman is nominated by committee with the consent of all members to open and close the valve at a regular basis on fixed time. Further, this person is responsible to check the leakage, minor maintenance of the pipeline and maintain equal distribution of water. In case of major damage the member households collectively go for the maintenance work. If any households fail to go for the work they have to pay Rs. 100 as a charge.

Initially, the monthly water charge of member household was Rs. 20, later it has been increased to Rs 25. The collected amount is used for payment of water watchman and maintenance work. To avoid the conflict and unequal distribution of water, they have made a single water distribution tap. Further, to ensure the equal volume of water supply to member household the poly pipe connected by each household is of the same size. The water watchman opens the main distribution tap every morning for one and an half hour.

Unlike this one of the water user committee in Upper- Kitam constitute five households. These households have jointly leased-in the water source at Rs 2500 annually from another village located around 2km distance. They have collectively constructed tank in the source and connected their pipeline individually. Each member household collects Rs 500 annually to give water source charge to source owner. They use water in day wise turn system.

Similarly, in Singithang four households have collectively purchased water source by paying Rs 10,000 to source owner and using water in regular basis.

> *"We five households collectively tapped water from the nearby village by paying Rs 2500 per annum to the source owner and we are using in turn system i.e. one day one household"). Chandra Kala Manger, Upper Kitam*

On the other hand in Lower Phalidara peoples are using water in per hour per household basis. There are twelve households who are accessing water from the tank constructed by RMDD of Government of Sikkim. There is no water management committee in this village as a result of which the conflict arises amongst the household in the matter of water distribution. Further, these households stay in the tank in night time especially during lean period to check the thief.

In Upper Sorok village, five households have formed water user committee and have constructed two tanks one is in the source and another water storage tank nearby the households. From the stored tank every member household access water on a regular basis.

It is also found that in Singithang, Rong, Upper Kitam and Upper Sorok villages, household of same families have jointly owned source and access water from the same source. They do believe that water sources and springs are the home of god and goddess. Every year they perform a ritual (Pooja,) at the water source (locally called Devithan) and avoid any kind of pollution and human interference in the source area. Water source in Sikkim is considered as a sacred place of worship.

Table 6.8: Male and Female Participation in Water Management Committee

Gender	No. of Households	Percent
Male	37	82.2
Female	8	17.8
Total	45	100.0

Source: Field Survey, 2015 -2016

Although the participation of the community in water management in Namchi is high but there exist gender gap. Table 6.8 clearly reflects that male from 82 percent of household are the members of committee while female from only 17.8 percent household are the member of the committee. This shows that participation of women is very low in the committees. The women are nearly excluded from the committee but their proportion in water collection is higher than the male. Since domestic water collection worldwide is the responsibility of the women. Within the home again management of domestic water is the women's responsibility (Ruth 1998). Women do possess extensive knowledge, experience and common sense regarding the use and management of water resources www.unep.org/pdf/women/chapter. Women are list involved in the formal and informal water management committee. Many studies on women participation in water resource management found very low participation of women in water management sectors. For an instant the UNESCO New Delhi report on Water User Association for sustainable water management in Tamil Nadu (Kulkarni 2013 and Onyango 2008). This is relevent to Namchi also as the participation of women is very less in the water management committee.

All the members of the water management committee are above 29 years. More than three –fourth of the participant in the committee are working age group people i.e. (Age group 29 – 59) and on an average 22 percent are old age people (above 60 years).

Table 6.9: Educational Qualification of Members of Water Management Committee

Education Level of member of the Committee	No. of Household	Percent
Illiterate	04	9.0
Primary	13	25.0

Upper Primary	14	31.8
Matriculation	09	20.45
High Secondary	03	4.54
Post Graduation	02	2.3

Source: Field Survey, 2015 -2016

Table 6.9 reveals that 91 percent of committee member is literate. But a large majority of household have primary to matriculation level of education. Four member of the committee are illiterate. So, an inference can be drawn from the above analysis that less educated people are more concerned and actively participating in water management committee in rural area.

The relation between the income of the household and participation in water management reveals that middle and high income groups are participating more individually than low income groups. Similarly, majority of member of water management committee are middle income groups. There is no social disparity in water management committee as all the social groups are equally participating but the gender disparity is clearly observed as majority of member of committee are male.

VI.6. Community Participation in Water Resource Management in NMC

Water management system in the urban area is different as compared to rural areas. In the urban area PHED, Government of Sikkim is solely responsible for supplying water to households. Further, the Department is responsible for the source and main pipeline maintenance from source to Zonal tank. From Zonal tank to the households the maintenance of pipeline is the responsibility of individual household. Water management work here includes connection of the individual pipeline from the Zonal tank, checking of illegal tapping on directed line, checking leakages, repairing of pipe and clearing of gas filled in the pipe. In this respect in urban area only half of the respondent household participates in water management. Further, the household

from which the male member participates constitutes 93 percent and the household from which female member participate accounts only 7 percent. A majority of participant are between the age group of 19 -59.

Table 6.10: Mode of Participation in Water Management

Mode of participation	No. Households	Percentage
Individually	50	50.0
Government filter	3	47.0
Nominated filter	01	1.0

Source: Field Survey, 2015 -2016

Half of the surveyed households in NMC have participated individually in water management in their own expenses while remaining are fully depends on the government fitter appointed at their respective zone.

Table 6.11: Education Level of Participant in Urban Area

Education level	No. of Households	Percentage
Illiterate	04	7.4
Primary	06	11.1
Upper Primary	16	29.62
Matriculation	07	12.96
Graduation	15	27.77
Post graduation	06	11.1
Total	54	100.0

Source: Field Survey, 2015-2016

The data on the level of education of participant shows that 93 percent of participants are literate and only 7 percent are illiterate. Amongst the literate, 62 percent are having an education quilification of matriculation and graduate. Overall, in the NMC mostly the educated people have participated in water resource management.

Table 6.12: Number of Days People Participate in Water Management per Month in Urban Area

Number of Days	Number of Households	Percentage
Below 5	43	79.62
6 – 15	06	11.11
30 days	05	9.25
Total participant	54	100.0

Source: Field Survey, 2015 -2016

Table 6.13: Number of Hours People Participate in Water Management in Urban Area

Number of Hours	Number of Households	Percentage
≤ 1	9	16.7
1-2	07	12.9
2-3	12	22.2
3-4	14	25.9
4-5	8	14.8
5-6	4	7.4
Total	54	100.0

Source: Field Survey 2015 -2016

The data on a number of days people participated in water management enables us to calculate the level of community participation. On an average 80 percent household in the urban area participated below five days in water management per month. There are five households who participate every day in water management. The data on time spend by households on the day they participate in water management work reveals that 16.7 percent spent less than 1 hour, 13 percent spent one to two hours while 48 percent household spent 2 to 4 hours which is highest amongst the respondent and 22 percent households spent four to six hours of time for water management. Though the water management and distribution is the responsibility of PHED, Government of Sikkim in urban areas but in Namchi peoples are not expecting from the department rather they are taking out 2-4 hours per day

from their busy time for the management of available water resource. A majority of people participate individually.

VI.7. Water Management Committee in Namchi Municipal Area

The households located in the urban fringed have formed a committee amongst themselves for the management of water resource. Though the committee has been formed by the rural people but still six urban households are also the member of the committee. The name of the committee is Water User Committee under Bomtar Samaj (Bomtar Society) which was formed in the year 1981. These households are not accessing water from Namchi water supply system but are accessing from Rural Management and Development Department. From among the six member households, five are male and only one female. Further, amongst the participants three members are under age group of 29-59 and other three are of old age people above 60 years.

In addition amongst this member one person is president, one is a treasurer and remaining are the members. The entire members are educated, having education qualification from Upper Primary to Graduation. This water user committee functions through the collection of money from the member households who access water from this source. Each member households contribute Rs 100 per month and the collected amount is used for the repairing and maintenance of pipe. If the maintenance cost exceeds the collected fund than member collect the extra money. Those households who are not able to participate in said date for maintenance work; they have to pay Rs. 200 as fine for not attending the event. The president of this committee is an ex-army person. He is a very active person who has taken initiative to find the perennial water source and worked hard to connect individual households with water and had form the committee. The other committee members had nominated him as a president

since many years. As he is a very responsible person, even today at the age of 70, he has taken the responsibility of opening valve in morning and evening per day for one hour to every household.

The above interpretation shows that participation of urban community in water management is less than the rural community, as in the rural area number of days people engage in water management is higher than in urban area. Further, rural communities have taken more responsibility of management of water than urban communities. In rural area number of water management committee is larger than in urban area. Further, they are generating money for the construction of tank and purchasing of pipe and other material for water management. In the rural area, majority of participant are less educated while in urban area mostly the educated people have participated. In both the rural and urban areas mostly the people between the age group of 19 –59 years old have participate in water management. There is no discrimination in terms of participation in water management amongst the social groups. But there is inequality in terms of male and female representation in water management committee. The study of Kulkarni (2013) from South Asia and India also came with the similar finding.

Besides, above mention initiatives of individual households and the committees, Government agencies are also involved in water security of the rural as well as urban area the details of which is presented in the following paragraphs.

VI.8. Role of the Institution in Water Allocation and Distribution

The main government department which is responsible for water supply in the village is Rural Management and Development Department, Government of Sikkim. Further, under this department there are various sections that are taking care of village water supply. Such as National Rural Drinking Water Supply Projects (NRDWP),

Mahatma Gandhi National Rural Employment Guarantee Act *(*MGNREGA), Dhara Vikash, Springshed Development. The household water connection is provided through NRDWP, construction of rainwater harvesting tank, household tank and maintenance of tank is mostly done through MGNREGA and identification of drying spring and rejuvenation work is undertaken through Dhara Vikash.

VI.8.i. Role of Rural Management and Development Department:

The RMDD is the State Government Department which has been involved in the activities of development of rural areas of Sikkim. This department implements various programmes and schemes related to rural development such as construction of road, bridges, houses, toilets, water harvesting tank, 100 days job guarantee under MGNREGA, drinking water supply, loans to Self Help Groups. In addition to this, department has initiated Chief Minister Rural Housing Mission to convert the katcha house to pucca house, reconstruction of Earthquake Damage Rural House.

This department is a nodal department to implement the rural water supply program in the state. To enhance the rural water security, this department has initiated climate change related vulnerability assessment and adaptation measures such as Dhara Vikash, Springshed Development and National Adaptation for Climate Change. Further, the department is continuously focusing on strengthen the governance of gram panchayat. RMDD is an umbrella body which provides fund to initiate different schemes in the rural area.

RMDD have provided household water connection to rural area under the schemes called National Rural Drinking Water Supply Programme (NRDWP). The detail descriptions of the programme are as follows

NRDWP: This is a National scheme to provide adequate, safe and potable drinking water to the rural households. The NRDWP is initiated by the Ministry of Drinking

Water and Sanitation, Government of India with the objectives to provide adequate drinking water to rural household, to empower communities to monitor and keep observation on their drinking water sources, to provide drinking water to Gram panchayat, all the Government Schools and Anganwadis. The funding pattern of NRDWP is different for Northeast states and Jammu and Kashmir then other states of India. For these states, 10 percent of annual NRDWP allocation is allocated. Further, to initiate this scheme 90 percent of fund comes from Central Government and 10 percent should generate from state while for other state it is 50:50 sharing of fund between Central and State. After the implementation of programme in village, Village Water and Sanitation Committee and panchayat are responsible for management and distribution of water.

In Sikkim NRDWP was initiated since 2009 to provide the household water connection to those who do not have water connection at their premises. This scheme is under water supply section in the RMDD, Government of Sikkim. Under this scheme the tapping of water from distance perennial sources and construction of community tank within the village is done to make water available to household. Before the start of this scheme in any village, the Department prepares a planning template know as Sikkim Rural Drinking Water Supply Planning and circulates it to the gram panchayat. The template contains a format of basic information of village and ward, water source, source sustainability during winter and summer, discharge volume, number of household cover and other guideline of scheme.

The role of department is to verify the water source (site) which is identified by the panchayat and local community to tap water as well as to check the draft of the project prepared by the Gram Shaba. In addition, the Department estimates the budget of project and sanctions the project. Subsequently, the Department sends notice to the

Block Development Office and Panchayat Office inviting open tender for the project. The role of Department is to supply construction material and timely checking of work. In addition to this they do the final verification of the project and issue of the final bill to the concerned contractor. Through NRDWP, RMDD have provided households water connection to almost all the households in every surveyed village. Another programme which is implemented by the RMDD, Government of Sikkim for the construction of water infrastructure is MGNREGA.

MGNREGA: It is a National programme to provide hundred days of guaranteed wage employment to rural household whose members volunteer to do unskilled manual work. Under this schemes RMDD initiate many work related to water resource management such as construction of harvesting tank, watershed management work, macro and minor irrigation work, renovation of traditional water bodies.

The Department provides household level water storage tank and harvesting tank through MGNREGA especially to those household who are facing water shortage problem and who do not have water storage facility. Beside this, the maintenance of water infrastructure like tank, canals, streams, plantation in source is also done under this scheme.

Besides the above mentioned schemes Dhara Vikash and Springshed Development are other such scheme which is implemented by RMDD for climate change adaptation and water security in rural area of Namchi.

Dhara Vikash: This scheme was initiated by RMDD, Government of Sikkim in the year 2008, with the technical support from WWF – India; People's Science Institute, Dehradun, ACWADAM, Pune, and Arghyam Bangaluru. Under this programme the drying spring, streams and lakes were recharged by controlling the surface runoff. This scheme is mainly started in South and West district of Sikkim. Under this

scheme the department prepared resource map of the villages with the full participation of villagers and finally prepare spring atlas. Simultaneously, recharge area of many drying springs and streams were identified. Further, to recharge the underground water, springs and streams, Department with the labour support from MGNREGA has constructed a pond and trenches in the upper catchment area along the slope to catch the runoff and make it percolate underground. The rainwater collected in the ponds and trenches percolate down and recharge the drying springs and streams. The positive result of this initiative is found in the villages where it was implemented. The villager found increase in discharge of spring especially in lean period.

Another programme initiated by RMDD, Government of Sikkim for climate change adaptation is National Adaptation for Climate Change (NAFCC). This programme is initiated especially for drought prone area. Under this programme, Department has started conducting meetings in eight drought prone block of Sikkim with participation of households, gram panchayat and officers from the department. During the course of the interaction with the community they tried to identify the problem related to water in the village as well as at household level. Under this programme the trained officials from the department prepared the water source mapping of village with full participation of villager. Further, they measured the seasonal discharge of sources. In addition to this they prepare the Village Water Security Plan (VWSP) with strong participation of villagers. This plan contains detailed information about water resource availability, source sustainability, household level water availability information and water demands of the village. Finally, the plan projects the alternative action for water supply in the village. The village water plan for Upper Kitam village has already been prepared.

These are the initiatives taken by the RMDD, Government of Sikkim for the allocation and distribution of water in the rural areas. Amongst these schemes NRDWP, water harvesting tank, household water storage tank and Dhara Vikash programme are implemented in the study area. In every village water is being carried from far distance source through pipeline and stored in the community tank through NRDWP. Further, household water connection has been provided to almost all the households in each of the surveyed village. Similarly, water harvesting tank is provided in almost every household especially in Rong, Upper Kitam and Sorok village through MGNREGA. Likewise, Dhara Vikash Programme for spring rejuvenation is also implemented in the water source of Upper Kitam Village, Sorok village and in water source of Lower Phalidara.

The role of RMDD, Government of Sikkim is to implement the problem specific schemes for water security in the villages. Further, the role of department is to sanction the projects and to allocate the fund for the same. Verification of the site is also done by officials from the department. Likewise, the Department supply construction material and timely monitors the project especially in the construction phase. In addition, department provides the guidelines of the project to the panchayat, VWSC and Junior Engineer accordingly they Plan, implement and execute the project. The budgeting of the project is also prepared by the department. The RMDD is the chief department which implements the schemes and provide fund for the construction of water infrastructures in the rural area.

VI.9. Role of Panchayat

The Panchayat plays a vital role in water management within the village. The gram panchayat is the village level water governance. The important responsibility of panchayat is to conduct the gram sabha with the involvement of all the villagers. The

gram sabha discusses about the water needs of the village, water source available in the village and what kind of water scheme is appropriate for the village. Further, the sabha discusses about water user charges. The gram sabha approves the plan and prepares the draft of the project. The panchayat co-ordinates with the district and block office for the approval of draft and getting finance. Further, the responsibility of the gram panchayat is to form a Village Water and Sanitation Committee and to nominate the barefoot engineer. Besides, the panchayat is responsible for monitoring of construction work to ensure the quality, monitoring of expenditure to ensure that the fund is used in the proper manner. The ward panchayat is responsible for ensuring the active participation of public of respective ward in gram sabha and water issues are adequately placed in village plan and draft. After the completion of any water project in the village, the Department handover the project to the panchayat for future maintenance and management. Here again the maintenance and equal distribution of water in the village is the responsibility of panchayat. For minor repairing of pipeline the panchayat manage the fund from the collected water user charges. Panchayat organized different water related awareness programme in the Gram Panchayat Kendra for the villagers. They are further responsible to monitor the household level water problem in village. The allotment of work related to the MGNREGA for construction of water infrastructure in the village is also the responsibility of the panchayat. The panchayat inspector fills the format and guideline for water project planning sent by the department and prepares the diagram of project and sent the template to the department. The template contains basic information of village and the detail information about water source and management aspects. At the time of the maintenance of water source and pipeline, the panchayat organizes a meeting with the water user household and fixed the time for event. The panchayat is responsible to

maintain the account of water user. Overall the panchayat plays a crucial role in water allocation and distribution in the village. From the phase of planning to implementation of schemes related to water, the panchayat play a vital role.

VI.10. Role of Committees

Village Water and Sanitation Committee is formed in every surveyed gram panchayat unit. This committee is formed by the panchayat under the guidelines of NRDWP. The committee is constituted of six to twelve members including all panchayat members. This committee executes along with the panchayat. VWSC is a very responsible body for the water management in the gram panchayat unit. They are responsible for monitoring the water source, monitoring the sedimentation tank, repairing of pipeline. Further, this committee is responsible for monitoring the household level water storage and hygiene. Furthermore, the committee is responsible to ensure the equal distribution of water amongst the household who access water from the community tank. The committee collects the monthly water user charges from every user households and deposits it in the panchayat office. The responsibility of the committee is to organize meeting with the water user households twice a year to discuss about the collected fund and future work related to water management. Further, the role of VWSC is book keeping and reporting, paying barefoot engineer, supervising the construction work, monitor the work of barefoot engineer, application for funding and reporting monthly and annual accounts.

Besides VWSC there are other informal water committees in every surveyed village such as Water Harvesting Committee, Water User Committee. These water user committees are formed by the villagers and are responsible for management of water in the village. The committees are responsible for maintenance of water sources and repairing of pipeline. The role of the committee is to maintain the equal

distribution of water amongst the households. They conduct meetings twice a year to discuss about the collected fund. The main role of these committees is to maintain the equal distribution of water to the household.

VI.11. Role of Water Security, Physical Health and Engineering Department in Urban Water Supply

In the urban area, Water Security, Physical Health and Engineering Department (PHED), Government of Sikkim is fully responsible for the allocation and distribution of water in the urban area. The role of this department is to provide clean and adequate drinking water to the urban households. Further, the Department is responsible for the collection of the monthly water bill, maintenance of water pipeline, construction of reservoir and appointment of water fitter. Unlike in rural area, the maintenance of water structure in the urban area is done by the PHED, Government of Sikkim.

VI.12. Process of Implementation of Water Projects

In the rural area, Rural Management and Development Department (RMMD), Government of Sikkim is the nodal department for the implementation of schemes related to water security. In the process of implementation, the demand for water has to be put forward by the villagers to the department with proper identification of the perennial source and the number of households it would sustain. The proposal has to pass in the Gram Sabha . After the preparation of draft the officials from the Department visit the site for the verification purpose especially in the winter season to check source discharge. After sanctioning of the project, the budgeting part is processed by the department. Subsequently, the department sends notice to the Panchayat office and Block Development office inviting open tender for the project. The person or group of people who win the tender starts the initial work with their

own money. Later in the mean time department issues the running bill. During the construction phase, official from the department timely checks the progress of the work. The material for the construction work is supplied from the department. The final bill of the project is issued to the contractor after the final work verification is done by the department. At the time of the issue of the final bill of the project, the department keeps 2 % of the total project amount as security money. In case the work is not found satisfactory and complaint is filed against the work within one year by the locals then the security money is used to complete the work. Finally when the work is up to the estimated cost and draft of the department then it is handed over to the concerned department. For the future maintenance and collection of water user charges from the beneficiaries, the department gives the responsibility to the concerned panchayat of the area.

So the village level water governance involves the Panchayat members and member of village water and sanitation committee. Besides, Rural Management and Development Department Government of Sikkim have been providing rainwater harvesting tank, household water storage tank and roof water harvesting technique to those households who are facing acute water shortage. In the rural area the spring rejuvenation work, a plantation in the source has been done under the scheme called dhara Vikash. Village Water and Sanitation Committee and Jal Kranti committee have been formed in the Gram Panchayat to look after the clean and adequate water supply and proper sanitation facility in the village.

In most of the village, water has been tapped from the distance source and carried through GI pipe and finally stored in a huge tank called community tank. From the tank water is distributed to every household through 15 mm GI pipe. The distribution system varies from village to village. Because of non-availability of

perennial water source within the village, in none of the surveyed village water is distributed 24 hours. For the maintenance work in the village like Kitam, Rong, villagers themselves are doing by generating fund.

The literature on community participation in water resource management from other state of India and other Asian countries have found inequalities in access to water in terms of gender, caste and power relation. But such social and gender discrimination in accessing water is not found in Sikkim. Further, water projects have been implemented with the full participation of the communities. Since, from the identification of perennial water source to the drafting of proposal of the projects is done with the involvement of local community. Apart from this the water management systems initiated by the local people are found successful to maintain equality in the society and solved the water related conflicts in the village. Further, such systems are found more transparent in terms of use of money and made local accountable to take responsibility of resource management and distribution.

In the study area, different committees are participating in water management since time immemorial. Before the implementation of water supply scheme, people used to manage their water resource in their effort with the traditional knowledge. Even after the initiation of the water projects in the village, communities are fully participating and taking the responsibility of management of water in a very systematic manner. Though the water committees are not registered with the Government nonetheless they are executing properly. Such kind of initiatives from the people is a positive symbol for sustainable management and development of water resource in Namchi. The water sources are considered as a sacred place and are locally called *Devithan* (a home of goddess). The local community collectively

performs ritual of worshiping goddess every year in every water source, where they prohibit human interference and pollution.

VI.13. Summary

Community participation in water management is very important, as the communities are the primary user and know better about the available water at their locality. Many indigenous practices of water conservation and management with strong participation of community in construction, repairing and maintenance work could develop a social bonding amongst the farmers and maintain the equal distribution of water. Participation of community in water management process generates a sense of responsibility and commitment towards the work. Furthermore, when a water resource is managed collectively then the responsibility of management in terms of cost is shared amongst them. Almost all the traditional water management system across India was practiced collectively by the water user. Such systems were found successful in terms of management and distribution of the resource. For instance, the traditional water conservation and management system of Himachal Pradesh is found successful (Sharma and Kanwar, 2009).

Community participation is significant in water management because it can solve the water related conflict in the society. Since time immemorial people across the world are participating in resource management formally and informally. There are large number of evidences which reflecting public efforts in environmental conservation as whole and water conservation and management in particular.

Local communities possess detail indigenous knowledge about water resource management, the way they need water for daily activities and the way they use. Further, they can analyse the historical change that occurred relating to water access and its usage. Local communities can effectively monitor and detect the person who

violates the rule set for the water connection and use in their locality. Local communities possess strong incentives and willingness to struggle for the access to water and they are also able to solve the conflict and dispute related to water resource management (Bruns, 2008). Many traditional water management practice of rural India still exist.

In India before independence people used to depend on the traditional water sources like stream, springs and well and were responsible for management and maintenance of the same. After independence Government implemented number of water projects especially in the southern and western India. But the schemes were implemented without the consent and willingness of local people. Hence, the project was not able to provide the benefits to the people and was not sustained for a longer period. The government had witnessed failure on the implemented scheme for more than a decade. After such a failure the government, private institution and organisation started involving the people and taking their consent for implementing the scheme directly related to them. In India, community participation in water resource management started since long back mostly in southern states for irrigation purpose. Farmers in Karnataka, Andhara Pradesh, Orissa, and Maharashtra have formed a number of the formal and informal committee for the management of irrigation water. Community participation in drinking water management in the proper sense and in formal approach was started only after the implementation of Swajaldhara, a drinking water scheme, which was earlier known as Rajiv Gandhi Rural Drinking Water Scheme in the year 2003. In this project the complete planning, execution and management of the water supply scheme were done by rural people. This scheme was successfully implemented in 55 districts of India and could sustain for a longer period of time. It is considered that the reason behind successful

implementation and sustainability of this scheme is the involvement of the rural community in the project.

The water projects which was implemented long years ago are not fulfilling the water demands in both rural and urban area, due to increase in population and their increasing demand of water for different purpose of use. Hence, people today are not waiting for the government fund and projects to get benefit from it especially in rural area. They have again started managing water resource collectively within a village.

Literature on community participation in water management clearly reflects the evidences from across the world that rural people are managing their available water resource by generating social capital, like labour, money and construction material. For instance the study of Narwani (2005) explored the traditional way of tank management system since British regime in Andhra Pradesh, the study highlighted that informal committee has been formed by villager for the clearing and maintenance of the channels. Further, committee monitors the inflow of water into the tank and the collectively decides the timing to open the sluice. The farmer committee has appointed water manager to attend to distribution beneath the sluice, he is paid in kind and cash. Those who do not attend for maintenance work are charged Rs. 25 per hectare and labourers are hired to do the cleaning since, the tank water is used for irrigation purpose.

People in Sikkim used to manage their available water resource through traditional knowledge prior to the implementation of water supply schemes planned and implemented by government of Sikkim. Till the late 1975, every household in the rural area of Sikkim used to collect water from different sources like pond, stream, spring and river. They use to collect water in vessel made of bamboo. Some of the

households used to use the bamboo pole to carry water from the source till house wherever the topography is suitable. Mostly, people used to use the bamboo pole to tap from the source to make it possible to collect for domestic purpose. Because of the economic condition and lack of the modern technique of using rubber or iron pipe to tap water from the source, availability of water within premises was a dream for the people. For the agriculture purpose farmers used to carve out the hill slopes along the gradient of gravity and divert the stream water into the canal and canalized it to the agriculture fields without any external support. Such canal is locally called (Kulo). This way the local community used to participate in water management.

With the passage of time to cope with water shortage problem, those households who were economically sound, they used to buy rubber pipe and tapped water collectively from distance source. On the other hand those who were not able to buy they used to connect water from those households with the help of bamboo pole. With such kind of initiative, in some of the village a cluster of 3-4 households started tapping water collectively in cost sharing basis. In this way helping each other to access water, people developed sense of community participation. Further, people used to perform rituals in the source. They used to consider water sources as a sacred place and they clean the source and they perform ritual collectively. This is how people started coming together to manage the available water in the villages.

Later, with the government initiatives during the 1977s, water supply scheme had been implemented in those villages which were facing acute water shortage based on the public demand. There was no individual water connection to the household, only one stand post was provided to 5-6 households from where the households used to collect water. For the minor maintenance of water tank and pipeline, Panchayat used to provide fund from their office and for the major maintenance work, fund used

to be provided by the concerned department. The water supply systems which were installed during this time were all demand driven not supply oriented. The demand for water supply used to be put forward from the village through Panchayat to the concerned department. Though the people used to participate as paid labour for the construction of water infrastructure but they used to work in full dedication and with the sense of responsibility.

After the 1980s, Government of Sikkim started supplying water in the iron pipe and the water tanks were constructed RCC. The distribution systems of water to the households were similar as before. But from the mid of the 80s, a massive rural drinking water supply was initiated and most of the households were covered with the water connection within premises for domestic purpose. Again in mid of 90s Government of Sikkim implemented the water project in the rural area for those households which was not covered by earlier projects.

Those water projects which were implemented during 80s and 90s are not able to provide adequate water to the people. It is mainly due to the increase in population and decrease in the discharge of source caused by climate change, leading people to the shortage of water. Hence, rural people have again started managing their water resource collectively. A cluster of households in every village has taken the responsibility of maintenance of water source and management of water resource in a very systematic process. Villagers have formed a number of informal committees to manage available water. They are generating capital and material for the construction of water infrastructure and distributing the available water amongst themselves in a very systematic way.

To manage the available water resource, rural households are participating in various water management works such as source maintenance, repair of pipeline,

construction of water tank, plantation near sources, organizing meeting, desiltation of tank, clearing of silt inside a pipeline, maintenance of tank etc. The field data on community participation in water management in the study area suggest that almost all the household participate in water management work. Further, number of male member participate in water management is higher than female. This is mainly because of distant location of sources. Majority of participant are youth between the age group of 30 -59 followed by population above 60 years old. The literacy amongst the participant reveals that around 75 percent of participants are literate. There is inverse relation between number of participant and level of education, which means higher the level of education of people lower the participation in water management work.

The households are participating through different mechanism. On an average 72 percent household participate individually while 28 percent participate as member of committee. There are 13 household who participate collectively. To know the level of community participation, data has been collected on number of days and time spent in water management. The study reveals that more than half of respondent household participate five days per month. Likewise, 35 percent household participates up to 25 day. There are some households who participate every day. Though the people spend almost every day, the time spend varies, as half of them spend two to four hours. An average time spend by people for water management is three hours. Water is considered as free gift of nature but the rural household of Namchi is paying price of its use. Monthly every household deposits Rs 10 -20 as water user charge to the panchayat. Besides, 35 percent household spends Rs 20 -100 for water access. There is variation in expenditure on water from household to household, because of differential rules of water management committee in villages.

Besides individual participation, villagers have formed number of water management committee for the management of water resource within the village. Water management which is found in the surveyed villages are Village Water and Sanitation Committee, Water Harvesting Committee, Water user committee and Jal Kranti Committee. The number of committees varies from one surveyed village to another, for example in Rong village there are three committees while in Sorok only one committee. The field data reflects that out of the total respondent household only 25 percent are the members of water management committee. This is because majority of households have participated individually. Further, the water management committee like VWSC, is formed at gram panchayat level to look after the water related issue of GPU, yet people in three villages Singithang, Upper Sorok and Lower Phalidara are not aware of this committee.

Village Water and Sanitation Committee (VWSC) has been formed formally through Panchayat office. This committee has been formed under the guidelines of NRDWP. Where Panchayat president is the Chairman of the committee, Panchayat members are members, Junior Engineer (JE) and Assistant Engineer (AE), one trained person designated as a barefoot engineer a (field worker) and two or three senior people of the gram panchayat. Altogether committee is constituted of 6 -8 persons. It is the task of barefoot engineer (fitter) to open a water distribution valve, maintenance work and to collect the water charge from every household. The responsibility of this committee is to take care of water security of the village. This committee is actively involved in planning, implementation and maintenance of water related infrastructure in the village.

Another committee is Water Harvesting Committee; this committee is formed by a villager to maintain equal distribution of water from the Harvesting Tank. Since,

Water harvesting tank is constructed by RMDD Government of Sikkim with the labour and material support from the villagers for water security in the village. This committee is formed in two villages viz Rong and Upper Kitam. But the structure, pattern and function of the committee vary from one to another.

This committee in the Rong village is constitutes of 13 households. To function in formal manner, committee constitutes the President, Vice-President, Secretary, Treasurer, and Water Watchman (fitter). To maintain the equal distribution of water from the tank, there is water watchman who opens the distribution valve at same time for equal duration to the entire member household. The household who want to access water from the tank pay Rs 500 as joining fee. In addition to this treasurer collects Rs 30 from each member household. In addition to this if the household fails to go for the maintenance and repairing work on the scheduled date they have to pay Rs 150 as fine. This collected amount is used for the monthly payment of fitter and for maintenance work. This committee maintains the account in the post office. The residual amount is deposited in the post office by the treasurer. Further, the member households are allowed to use money from the post office for their personal work but they are liable to pay rate of interest fixed by the committee. This committee conducts meeting in every six month to discuss the account details and water related issue. The committee is functioning in a systematic manner and is able to manage water equally to the household and empower the people.

In Upper Kitam village RMDD Government of Sikkim tapped water from the Mikkhola stream and stored in a tank of 10000 litres at Upper Kitam. Households accessing water from this tank have formed committees in which Panchayat members are also the member. Even in Kitam water harvesting committee functions with the money collected by the member household. But the process of joining and fee

structure is different. To access the water from the tank, the households put forth an application along with Rs.300 as joining fee. In addition, the barefoot engineer collects monthly water usage charges of Rs. 30 from each member household. The collected amount is deposited in the Panchayat office. The collected money is used for the payment to the fitter and for water management related work. To avoid the water thief and unequal distribution the main valve is kept in the lock system. The fitter is the only authorised person to lock and unlock the system. Another water committee found in the rural area is water user committee.

In each of the village, a group of households who are accessing water from the one source have formed committee which is termed as water user committee. The member of this committee also collects Rs 20 – 45 per month and uses this money for the construction of tank and maintenance work. For the maintenance work they go collectively. In Rong village this committee is functioning similar as the Water Harvesting Committee. While in Upper- Kitam five household have formed committee. These households have jointly leased-in the water source at Rs 2500 annually from another village located around 5km distance. They use water in rotation system of per day per households basis.

It is also found that in Singithang, Rong, Upper Kitam and Upper Sorok villages, household of same families have jointly owned source and access water from the same source collectively. They do believe that water sources and springs are the home of god and goddess. Every year they perform a ritual (Pooja,) at the water source (locally called Devithan) and avoid any kind of pollution and human interference in the source area.

Although the participation of the community in water management in Namchi is high but there exist gender gap. The participation of male member of household is

higher than female in the committee. The female are nearly excluded from the committee. As from majority of the household male head of the family are the members of committee. The age group of majority of committee members is 29 -59. The committee is constitutes of literate people, as more than 85 percent of committee member are literate.

These formal and informal water management committees in the rural area were able to manage limited water and distribute to every household in equal manner. Further, through these committees villagers could generate the feeling of responsibility of resource conservation management. Furthermore, they could to solve water related conflict within a village and also developed the social bonding. Besides this, mechanism of water management could empower the villagers and make them accountable to manage their resource themselves. So, this is how in the rural people of Namchi are participating and managing the water resource within the village.

Though in the Namchi Municipal area, PHED of Government of Sikkim is responsible for providing water service yet the household are participating individually. Amongst the respondents household half of the household have been participating in water management work. The male participant is higher than female. In NMC, mostly the educated people have participated in water resource management. The number of days household participate in water management in NMC is less as compared to rural area, as majority of household participate below five days per month. Similarly, time spend by household per month for water management work is less than in rural area as in the NMC the concerned department takes care of the maintenance of pipeline and water source due to distant location of the source.

Amongst the respondent household, six household are the member of water management committee. These household are located in periphery of NMC and are accessing water from stream. Though the committee has been formed by the rural people, they are also the member of the committee. The name of the committee is Water User Committee under Bomtar Samaj (Bomtar Society) which was formed in the year 1981. This committee functions similar to that of water user committee of rural area. These six household are participating very actively for water management.

Besides, above mention initiatives of rural and urban households for water management, government department, Panchayat and different water committees are playing a crucial role as a service provider to both the rural as well as urban area.

The RMDD and PHED, Government of Sikkim are two important Government department which has been involved in rural and urban water supply in Sikkim. The RMDD is government department which has been involved in various rural development activities including rural water security. To ensure the rural water security, this department has initiated various water related schemes such as, National Rural Drinking Water Programme, household water storages tank, rain water harvesting tank, and roof water harvesting techniques, spring rejuvenation through Dhara Vikash etc.

This department has provided household water connection to individual household through NRDWP. Similarly, under MGNREGA, the department has provided household water harvesting tank and roof water harvesting system especially to Schedule Caste and Schedule Tribe.

The role of RMDD, Government of Sikkim is to implement the problem specific Schemes for water security in the villages. Further, the role of department is to sanction the projects and allocate the fund for the same. Verification of the site is

also done by officials from the department. Likewise, the Department timely monitors the project especially in the construction phase. The department supplies the construction material for the project. Further, it gives training to the gram panchayat, barefoot engineer, fitter, member of VWSC and other water committees. In addition, the Department provides the guidelines of the project to the panchayat, VWSC and Junior Engineer accordingly they Plan, implement execute the project. The budgeting of the project is also prepared by the department. Furthermore the department conducts various awareness program related to climate change adaptation, water conservation and sanitation program.

Similarly, the panchayat play a crucial role in the water supply and management within the village. The panchayat is village level water governance. The departments have decentralized the responsibility of water resource conservation and management to the Panchayat. The important responsibility of panchayat is to conduct the gram sabha with the involvement of all the villagers. The gram sabha discusses about the water needs of the village, water source available in the village and what kind of water scheme is appropriate for the village. After preparing scheme proposal in the gram sabha, the panchayat co-ordinates with the districts office and concerned department for further process. Further, the panchayat are responsible to form the Village Water and Sanitation Committee. The Panchayats monitor the ongoing water projects within village and updates the progress of the work to the Department. The Panchayat allocates the fund collected from the water users for the maintenance work. Furthermore, the role of Panchayat is to organize meeting with the water user household. The Panchayat are the main body who plan and implement the water related schemes in the village.

Besides, there are various water management committees constituted in the villages to maintain equal distribution of water amongst the household. The committee like VWSC is functioning along with panchayat to look after the water related issue within the gram panchayat units. While the committees like water user committees and water harvesting committee is formed to maintain the water source and maintain the equal distribution of water from the tank to every user household. In addition, the committee generates the awareness regarding the water conservation and judicial use within household. Furthermore, the collection of water user charges and use of fund for various water management works is the responsibility of water user committee. So, in every surveyed village a cluster of 6-10 household are coming together and taking the responsibility of water management and distribution within the village.

In the urban area, Water Security, Physical Health and Engineering Department (PHED), Government of Sikkim is fully responsible for the allocation and distribution of water in the urban area. The role of PHED, Government of Sikkim is to provide clean and adequate drinking water to the urban households. Further, the Department is responsible for the collection of the monthly water bill, maintenance of water pipeline, construction of reservoir and appointment of water fitter. Unlike in rural area, the maintenance of water structure in the urban area is done by the PHED, Government of Sikkim.

So, the government departments are constantly involving in providing water security to the rural as well as urban household. At the same time the local communities at the village and household level are also actively participating and taking responsibility of management of water. As a result the household would be

able to have a water to run their livelihood in such an area where the rainfall is very less and springs and streams are non-perennial in nature.

Though the water committees are not registered with the Government nonetheless they are executing properly. Such kind of initiatives from the people is a positive sign for sustainable management and development of water resource in Namchi.

CHAPTER VII

Conclusions

The present study is based on enquiry about the water resource management and community participation in the rain shadow zone of South Sikkim. The area is the rain shadow zone where the rainfall is very low leading to the water shortage problem. Hence, the present study was undertaken with the objective to know about the water availability status, mode of access, purpose of use and management system in Namchi block of the South Sikkim. It seeks to know about how the local people are coping up with such situation.

Further, the study was based on the ground that community participation in water resource management is an important tool to solve the resource related problems. In addition, the local communities actively participate in water resource management and there is no gender gap in participation. Fetching water from distant places and collecting rain water are the alternative adopted by the local people to cope with the situation. Women had played a vital role in water resource management within the households. The attempt was made to understand the community participation in water management and role of different institutions for water security in rural as well as urban area of the dry part of South Sikkim.

The study of history of water management system in India provides the idea that the water management system had prevailed in India even during the per-colonial period. During that period people used to manage water resource with traditional knowledge collectively. While during British Rule in India the large scale water infrastructure were developed for the management of water but could not be successful due to the non-cooperation from the local communities. As a result many traditional irrigation systems were brought under the government control and imposed

taxes on its usage and many of them banned by the Government. Water management system after independence shows that government had made huge investment in establishment of tanks, wells and tube well for irrigation as well as domestic use. But the control over this was centralized to the government department only. The management system was somewhat similar to the British rule. The water infrastructure developed during that period did not sustain for longer period of time due to biased distribution system, only the highly influential farmers took the benefit of water. To solve this problem the Government initiates awareness programme and educating farmers concerning the efficient use of water.

The concept of community participation in resource management started since 1990s. When it was realized that technology alone cannot solve the problem related water resource management without involvement of local community, since then the concept of community participation in water resource management has spread worldwide. In India, participatory water resource management has started from the southern states like Tamil Nadu and Karnataka where farmers and water user groups were involved in water management. The outcome of this experiment was very successful which could lead to solve the water problem, empowered the farmers as well as maintained the sustainability of project.

Similarly, participatory approach in drinking water management started after initiation of Swarjaldhara project in different states of India. Apart from the institutional involvement of water user in water related project, the local people have been participating in water management for their domestic needs like for drinking, cooking and for cattle as well as for irrigation. There are number of studies which have highlighted success stories of the community effort for water resource management in different part of India and other countries of Asia as well. For

instance ‘Weir system’ of North Thailand, ‘Subak’ in Bali Indonesia, local community water management system of Sumitra, Indonesia and ‘Done’ in Bangladesh are the indigenous water management system practice by local community which is functioning very systematically and entirely through capital generated by the user group.

Similarly, in India people practice indigenous water management system through community participation. For example Apatani water management system of Arunachal Pradesh, Bamboo drip irrigation system practiced by local tribal framer of Meghalaya, Roof top water harvesting in Mizoram, *Baudi, Nawn, Chhrudu, Khatri, Khad, Nala* of Himachal Pradesh, traditional water harvesting system of Kumaun (*Guls, Nalas, Dharas, Lakes, Kund, Khal, Simar*), community based water distribution system called Damasha in Karnataka, Dong System in Assam, eco-friendly technique of water management in Kumaun are some of the innovative water management system which is being practiced by local people

The literature on women and water management explored that water management system through community participation have overlooked the role of women in water conservation and have nearly excluded from water management aspects. Still in many parts of India Dalit women are restricted to access water. The study on Kumaun has found gender disparity in water access. Further, representation of women is very low in water management committees (Kulkarni 2013).

Before proceeding to the community participation in water resource management in Namchi, firstly the study examined the water resource availability in South Sikkim and Namchi block. Water resource in Sikkim is available in different form viz river, glacier, lake, rainfall, spring and streams. Glacier is an important store house of water and the main source of major rivers of Sikkim. The glaciers and

natural lakes which feed the rivers and streams are confined in north and west districts of state only hence, South Sikkim do not have such lakes and glaciers which could provide direct water for human use. Sikkim has two main rivers i.e. the river Teesta and the river Rangeet. The district wise distribution of rivers reveals that 66.3 percent is in west and north district and remaining 33.7 percent is in South and East district. As compared to all other three districts of Sikkim, South district comprise of very less number of rivers further, most of the rivers are non-perennial in nature. Only the southern part of South district is drained by the river Rangeet. Similarly, spring is an important source of water for rural people.

Likewise, water available in the form of rainfall is also very limited in South district of Sikkim. The comparative analysis of average annual rainfall of South Sikkim from 2005 to 2014 reveals that the lowest average annual rainfall was recorded in the year 2013 i.e. 88.3mm and the highest average annual rainfall was recorded in the year 2007 i.e. 195.3 mm. Overall the South district receives very scanty rainfall. The district receives maximum rainfall from the months of April to September while remaining months it receives very less rainfall. The district records almost no rainfall for four months (November to February) for ten years.

Total water available in South Sikkim is 0.01295 million cubic metre (MCL). Further, water available in various water bodies including rainwater harvesting storage and surface store water is 0.01282 MCL and water available in perennial sources is 0.000116 MCL. Water available for irrigation is shown by gross irrigated area which is 1878 hectares (District Irrigation Plan, South Sikkim). Overall the availability of water resource is very limited in South Sikkim.

Likewise, in Namchi block there is no large rivers to drain. Most of the streams which drain the block are non-perennial in nature and dry up in the lean

period. Further, the rainfall data of three years (2012 - 2014) shows that the Namchi received highest rainfall of 144 mm and lowest 1.5mm.The block did not receive rainfall in the months of November, December and January for consecutive three years. During these months the springs and streams gets dried up leading to water shortage in both the rural and urban area. The water availability of Namchi is only 0.003 million cubic metres.

It is evident from the above discussion that the water availability in both the district and block is less. Further, the four months from November to February, the South district as well a Namchi block remains dry as, there is no rainfall.

The Census of India 2011 reflects that tap is an important source of water for both rural and urban households in South Sikkim as well as Namchi. The second important source is spring. The data reveals that only half of the rural household in South Sikkim has access to drinking water within premises. The scenario is similar in Namchi also. This means still large number of household in rural areas are spending the time to access water from the sources located away from the home.

The household surveyed data on access to water, types of connection and frequency and duration of supply, storage facility is discussed in the next paragraphs. The field data demonstrates that in every surveyed village, water has been tapped from far distant sources and stored in community tank and from the tank household tapped water. In Rong and Lower Phalidara village household have connected water from tank individually while in Kitam, Upper Sorok and Singithang village government department have given the household connection from the tank. So the Government Community Tank is the main source from where majority of the household access water. Likewise, the second important source is stream and spring. There are two government water service provider in the study area i.e. RMDD and

PHED. The half of the household have private water connection from government community tank, streams and springs and the remaining have RMDD and PHED, government connection. The household having government connections are low income groups. The household near to the urban area like upper part of Upper Sorok and Singithang have PHED connection but the supply is not regular i.e. once a week that too for 30 minutes. Even the households who access water from community tank do not get regular supply of water. Though almost all the household have water connection at their household premises, the supply is not regular. Twenty four hours of water supply is a dream for large majority of rural household.

There is no caste based and gender based discrimination in term of access to water in the rural area of Namchi. But in term of number of water connection, high income household have more than one connection than other income groups.

Because of irregular supply of water every household stores in every possible container varies from tank of 2000 litres to jar of 2-5 litres. Due to irregular and less duration of supply, the household are not getting adequate water for daily consumption. So to make water adequate for the household use, they collect water from different distant sources. On an average more than half of respondent household fetch water from outside sources. To collect water people travel one kilometre for single trip. Some of the households spend 3 hours a day to collect water. A large majority of household make two trips to collect sufficient water per day. It was revealed during interaction with the people that in the dry period the task of one to two persons from each of the household is to collect water. So engaging oneself whole day in collecting water is not only about the economic loss but physical stress also. Collection of water is considered as female work as from 70 percent of household female member collects water.

Even with this limited stored water, rural household are managing to use it for different purposes. The major purpose of use of water in rural area is for domestic, livestock, watering vegetable and flower. Amongst these purpose of use, the main purpose of use is domestic and livestock.

Another alternative which has been adopted by surveyed households to cope with water shortage problem is rainwater harvesting. More than half of surveyed household practice rainwater harvesting in rural area. The Government has also encouraged the people to practice rainwater harvesting by providing storage facilities like rain water harvesting tank for mostly Schedule Caste and Schedule Tribe household. Likewise, in Upper Sorok, Upper Kitam and Lower Phalidara village almost every household practices roof water harvesting by using their own techniques. They collect roof top water by using bamboo pole, rubber pipe and jar. The collected rain water is used for the domestic as well as for cattle.

The above discussion is about the water availability status and the way rural people are dealing with the water shortage situation. In the following paragraphs we will discuss about the urban water supply system of Namchi and household level water availability status and mode of use.

Unlike in rural area, water supply in urban area is provided by PHED, Government of Sikkim. The present water supply system of Namchi town came into operation in 1989. The water source of Namchi town is Bermelli Khola, which is 46km far from Namchi located in Ravangla block within South Sikkim. Water is tapped from this source from two sites, source I and source II. The tapped water from 46 km distance is stored in a reservoir located above the town. Likewise, another source of water for Namchi town is the river Rangeet. Water from the river Rangeet is

pumped and stored in the tank located in Solophok above the town. Though there are two sources Bermelli is the main source of water for Namchi town.

From the reservoir water is distributed to zonal tank located in six different locations within the town and from the zonal tank water is connected to every household. In each zonal tank, Department have appointed fitter to open the valve and to look after the pipeline. Even in the urban area water supply is not regular. Households get water in every alternative day per week for an hour. The Department collects water usage charges from the user house.

The field survey data demonstrates that government tank is the main source of water of urban household and second important source is stream. Those household located in urban periphery have stream as main source of water. Moreover, every household have water connection but the supply is not regular. Further, the disparity is found amongst the household in respect to number of water connection and duration of water supply. Disparity in terms of connection is due to lenient rule of the department for number of water connection as there is no restriction in terms of the number of connection. The latter is due to the bribe taking practice of fitter. The fitter gives more duration of water to those who gives money to them. This is also an important factor for water problem in Namchi.

It is found that the system of collection of water usage charges is also not followed as per the government notification (Sikkim Water Supply (Amendment) Rules 2014). As per the rules the water charge is based on the number of tap connection but it is found more than half of respondent household pay Rs 90 irrespective of tap connection..

Due to irregular and less duration of water supply, urban household gets inadequate water as three-fourth of respondent household reported that water supply

provided by PHED is not sufficient for daily consumption. Hence, to fulfil household water requirement, they buy water from the private supplier and from fitter also. The study found that nearly half of respondent household purchase water. The frequency of water purchase varies from twice in a year to once a week. To make water available in non-supply days, households store water in every possible container varies from dram of 100litres to tank of 5000 litres. Purchasing water is one of the alternative adopted by urban household, others are fetching water and collecting of rain water at household level. Households also purchase water from fitter.

Out of total household, half of them purchase water and 30 percent fetch water to make it available for domestic purpose in non supply days. Unlike rural area, in Namchi town the participation of male member is higher than female in water collection. On an average 71 percent household collects water by covering an average distance of 0.5 km from Kazitar Dhara. The time taken for the water collections vary, as 76 percent household spend 30 minutes while remaining household spend 1-2 hours. A majority of household collects water twice a day.

The water in urban area is mainly used for the domestic, watering flower, commercial purpose. Amongst these the household who use water for domestic and watering flower constitutes highest followed by commercial.

Another way people are managing to have water at home is rainwater harvesting. More than half of the respondent household collects rainwater and use it for different purposes mainly for washing cloths and cleaning home followed by use in toilet and watering flower.

The urban households are not satisfied with the present water supply system of Namchi town. More than four-fifth of household reported that they are not satisfied with the present water distribution system.

The present water supply system suffers from the leakage problem, illegal connection, illegal tapping from the way and flexible water connection rules as there is no limitation on the number of water connection per household. In addition, the practice of paying extra money to the government fitter for extra supply of water is one of the very serious problems prevailed in town which is mainly practiced by the economically sound households and the consequences of which have deprived economically weaker section to avail adequate water. Another fact is that mostly the tenants are vulnerable to water shortage.

To maintain the equal distribution of water and user charges, installation of meter system is very essential. It was revealed from interaction with people that high income household having five to six storage buildings did not agreed for the installation of metre system while 87 percent of households strongly agreed for the meter.

To provide the water regularly and for round a clock, PHED, Government of Sikkim have initiated new water project Bermelli II to provide a regular supply of water to every household but projected completion phase of project is 2046. The proposed level of water supply is 135 litre per capita per day (lpcd) and 40 lpcd for floating population (PHED, Government of Sikkim).

In addition to the above mentioned practices of water management, communities are highly participating in water management in both the rural and urban area. In the rural area people have come together to manage water resource by forming number of committees. So, the following paragraph will contain finding and conclusion of community participation in water management in both rural and urban area of Namchi.

Community participation in water management is very important to maintain the equal distribution of water and to solve the water related problem within the village. Further, it generates the sense of responsibility and dedication towards the work. As the local community know better about the availability of water in their locality and best way to manage it. Many indigenous method of water management practice with full participation of community in different parts of India is still practice and able to provide equal water to the user and have empowered the community.

The data on community participation in water management in rural area shows that almost all the sample household participates in water management in various capacities. The participation of male is higher than female in management work. The reason for the higher male participant is that the locations of water sources are very far from the village and have to go through rugged topography and cliff which required rigorous physical work. It is very essential to know about which age group people in the society are concerned about the resource conservation. So the field data suggest that the people within the age group of 30 to59 are highly involved in water management work. The literate people are participating more than illiterate people. The people are participating individually as well as a member of committee. A large majority of household participate individually, followed by as committee member. The data on number of day and time spent by participant in water management reveals that more than half of household participate five days for month or say one day per week. A large number of household participate for 25 days per month and some household participate every day. The time spent by the household on the day they participates reveals that half of household spend 2- 4 hours, while 23 percent spent less than one hour and 12 percent spend 7-8 hours. Household who are engaged every day spent on an average one hour. The water source of most of the village is located

far distance (approximately 5- 10 km) hence at the time of maintenance work households spends 7-8 hours a day. This discussion shows that the community participation is very high in rural area. Even in the rural area people access water by paying money. Every respondent household pay monthly water usages charge to panchayat and water committees. The water charge varies from Rs 20 -100.

In the rural area, people are participating in water management by forming number of committees within the village. In every surveyed village clusters of household have come together and have taken the responsibility of management of water in a very systematic manner by generating money amongst themselves.

The name of the water management committees found in the surveyed villages are Village Water and Sanitation Committee (VWSC), Water User Committee, Water Harvesting Committee and Jal Kranti Committee. The water management committee is not equally distributed in five surveyed village. The participation of male is higher than female in the committees. The age group of majority of committee members is 29 to 59. A large majority of committee member are literate.

The large number of water committees is found in Rong village, followed by Upper Kitam and in other villages only few water user committees are found. VWSC committee is constituted in every gram panchayat. This committee mostly constitutes of panchayat and officials only, however one member from one village is included in the committee. VWSC is responsible to take care of water security of the village. This committee is actively involved in planning and implementation of water related infrastructure in the village. It was revealed from the interaction with the people that in Lower Phalidara, Upper Sorok and Singithang people are not aware about this committee while in Rong and Upper Kitam some of the households are member of this committee and aware about the function of the committee.

In Rong and Upper Kitam village water harvesting committee is functioning very systematically. The committee is formed by villager to maintain the equal distribution of water from the tank. The household who access water from the tank are the members of committee. The treasurer of the committee collects Rs 500 as joining fee and monthly charge Rs 25 from every member household. They conduct meeting twice a year to discuss about the collected fund and future water work. The frequency of participation in water management work is varies from season to season as, in monsoon once in a week while in other season once a month. They use money to pay salary of fitter and to buy repairing material. The committee fixed the day for the maintenance work and informs the user households, if any household fail to attend the event they pay Rs 200 as fine. Further, the treasurer is responsible to deposit collected amount in the post office. The member households are allowed to use money from the post office for their personal work but are liable to pay rate of interest fixed by committee. The water is supplied to the member household once in every morning for 1 hour. This system has made people more accountable and confident enough to take the responsibility. Likewise the water harvesting committee of Kitam is also function in almost similar manner but the fund collection pattern is varies. In Upper Kitam they collect Rs 300 joining fee and Rs 30 as monthly charges. Further, to access water from tank, household have to put forth an application to Panchayat office. A very interesting fact is that to avoid the water thief and unequal distribution the main valve is kept in the lock system. The fitter is the only authorised person to lock and unlock the system.

The water user committee is found in all five surveyed village but the committee in Rong has been functioning in very formal manner as similar to water harvesting committee. Water user committee of Rong constitutes of 13 households.

This committee collects monthly Rs 25 from the member household. They conduct monthly meeting and discuss about the fund utilization. The committee has nominated water watch man to open and close the valve at fixed time for the user household. The payment of watch man is made from the monthly collection. While in Upper Kitam this committee is constituted of five household. These five household leased-in the water source in Rs 2500 per year from another village and tapped water collectively. They use water on per day per household basis. They perform rituals in the water source annually with belief that god will maintain the source discharge. Further, they prohibit human and animal interference around the source.

The middle income group households are participating more in water management both privately and through committee as compared to low and high income group people. The participation of female is very less in water management work. Further, their representation is very less in water management committee; they are nearly excluded from the committee both in the rural and urban area. As the study from other states shows that there is discrimination in term of access to water based on caste and gender but in Namchi gender and caste based disparity does not exist in terms of access to water. But the gender gap exists in term of water collection. Female member of households involves more in water collection than male in rural area.

These water management committees in the surveyed villages are not only able to distribute the limited water equally to the household and take care of water source maintenance but have made the people accountable to take various responsibilities. Further, the committees were able to develop the social bonding in village, empowered the rural household and could solve the water related conflicts within the village. This proves the fact that water can be best managed through

community participation. Overall community participation in water management in rural household is very high.

Though the monitoring of pipeline and supply of water to the households is the core duty of government fitter however, the urban communities are not fully depending on the government fitters and plumbers to manage and maintain their water supply. More than half of responded household participate in water management work. Even in urban area there is gender difference in participation, as the participation of male is higher than female in water management work. The number of days household participate in water management in NMC is less as compared to rural area, as majority of household participate below five days per month. Similarly, time spend by household per month for water management work is less than in rural area, as in the NMC the concerned department take care of maintenance of pipeline and water source due to distance location of source. So, the day households are engaged in water related work they spend 2-5 hours.

There are six households located in the urban fringe who are the members of water management committee of adjoin rural area. The name of the committee is Water User Committee under Bomtar Samaj (Bomtar Society) which was formed in the year 1981. This committee is functioning with the capital collected from the member households, per month they collect Rs 100 per households. The committee collects Rs 200 as a fine from those household who fails to take part in water management work.

Such initiatives of both rural and urban households are a positive indication of sustainable water use and management.

Besides, above mentioned initiatives of local community for water management, government department, panchayat and different water committees are playing a crucial role as a service provider to the rural as well as urban area.

Government of Sikkim is constantly trying to provide 24 hours of water supply to every household. The RMDD, Government of Sikkim is the main department which has been playing a crucial role to provide water security to the village. This department has implemented number of water projects in rural area viz household water connection, roof water harvesting scheme, rain water harvesting tank, household water storage tank, recharge of drying stream and spring through Dhara Vikash. The department organize awareness program at district as well as village level. Further, the department provides training to the member of VWSC and other official. The department allocates the fund for the construction of water infrastructure for both irrigation and drinking water in the villages. Similarly, role of Panchayat is also very crucial in the village water security. The panchayat is the village level water governance. These days department have decentralized the responsibility over the resource conservation related work to the panchayat. The panchayat conducts the gram sabha along with the villagers and officials from the Block Development Office. They prepare and pass the proposal for water projects like for major maintenance of tank, pipeline, or for new water connection. The approving of draft and getting finance is the responsibility of the gram panchayat. The panchayat are responsible to form Village Water and Sanitation Committee. Besides, the panchayat is responsible for monitoring of project construction work to ensure the quality and use of fund in the proper manner. After completion of the water project in the village again the panchayat is responsible to take care of it. There are different water management committees in the village as discussed in the chapter-V. VWSC is

the standing committee constituted in gram panchayat level, this committee looks after the household level water availability status. Further, the role of VWSC is book keeping and reporting, paying barefoot engineer, supervising the construction work, monitor the work of barefoot engineer, application for funding and reporting monthly and annual accounts. The committees organize the awareness programme on judicial use of water and maintain of hygiene at household level. Beside this there are other water management committees constituted by the villagers. These committees have taken the responsibilities of monitoring the water source, and water supply condition, monitoring the sedimentation tank, repairing of pipeline by collecting money from each member household. Further, they have ensured the equal distribution of water from the tank to every member household. They function independently without involving with panchayat.

Though the water committees are not registered with the Government nonetheless they are executing properly. Such kind of initiatives from the people is a positive symbol for sustainable management and development of water resource in Namchi.

The area in which the water resource is very limited, less rainfall and least perennial water sources and very irregular water supply, the community participation is the best mechanism to manage this limited resource in very systematic manner. The above mentioned initiative initiated by the local people and their very active participation in water management enables the management of the limited water resource in rain shadow zone. The data yielded by this study provide convincing evidences that the community participation is very important for the management of water resource, especially in the rain shadow area. It has further been proved from the study that community participation has enable the people to aware about the resource

availability, judicial use of resource and empowered them to take the responsibility of managing their resource without external support. This approach has established the fact to bring unity in the society and solved the conflict on resource use of the village.

The literatures on water access and management system from international contexts have made the argument that there exists gender based discrimination in terms of access to water. The study from national context also have made argument that caste and gender based discrimination prevails in India for accessing water. But such issues do not prevail in both the rural and urban areas of Sikkim. All the social groups access water equally in Sikkim. Further, there is no gender disparity in Sikkim in accessing water but in terms of water collection participation of female is much higher than male. In Sikkim water collection from outside sources for households need is the responsibility of women.

The literature on community participation in water management from Asian and Indian context shows that water management through community participation has brought a success and sustainability of water projects. Such approach could maintain the equality in the society in terms of equal access of water as well as empower the people to take the responsibility of resource management. The findings of present study also suggest that community participation has brought positive result in terms of sustainability and equal distribution of water. For instance, village where the people are involved in water management by forming committees is able to maintain the equal distribution of limited water efficiently and equally to all the section of society whereas the villages where such committees do not exist are more vulnerable to water shortage and are frequently reporting conflicts. Further, the literatures argued that female representation in water management committee is lower than male and they are nearly excluded from the committee (Kulkarni 2013) virtually

same scenario prevailing in Sikkim. As the present study found that the representation of female is much lower than male in water management committee.

To conclude, as the study highlights, the availability of water is very limited in Namchi and present water supply of town is being operated since around 30 decade back. At that time population was very less but today Namchi is one of the fastest growing towns of Sikkim. So to tackle this problem searching for alternative source of water for a Namchi town is very essential. In the rural areas water management committee formed by villagers needs to register with government so that the committee can function smoothly. Government should encourage and generate the awareness amongst the people of other parts of state regarding the long term benefit of community participation in resource conservation and management.

Suggestions

1. There is no perennial water source available in an around Namchi town and also in rural area therefore, implementation of extensive rain water harvesting scheme is very essential to cope up with the growing water shortage problem in Namchi.
2. There should be mandatory rules for the urban households to architect the house with roof water harvesting structure which would enable them to have water in the dry period.
3. It is essential to check the illegal connection to ensure the equal distribution of water since, there are number of connection which has done without following rules. Likewise, tapping of water illegally from others connection has been observed during field survey.
4. There should be a proper monitoring and maintenance of leakage of pipelines between zonal distribution tanks to households. Introducing leakage monitoring system and water audit would help to minimize the losses from distribution system and will increase the efficiency of water supply system.
5. The work of the fitters is to be monitored frequently since bribe system exists and leads to uneven distribution of water in NMC.
6. New water tax system is highly required to implement in NMC. Since, the existing water tax collection system is very unsystematic.
7. Water metering system for the water distribution network should be setup for maintaining equitable, optimal and fare supply.
8. timely monitoring and maintenance of installed infrastructure like tank, pipeline is needed in rural areas since, many water storage tanks and pipelines are not in use due to lack of maintenance. Subsequently government should frame policy

for the maintenance of water infrastructure in every two years. Attention should be given to the household located above the source as they are the most vulnerable to water shortage.

9. State should have accountability and accessibility of data on water.

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