WATER SCARCITY AND ITS ADAPTIVE MEASURES:

A CASE STUDY IN CHYASAL, LALITPUR

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A Dissertation

Submitted to

School of Education

In partial fulfilment of the requirements for the Degree of

Master in Environmental Education and Sustainable Development

Kathmandu University

Dhulikhel, Nepal

April, 2013

AN ABSTRACT OF THE DESSERTATION OF

Soni Shrestha for the Degree of *Master's in Environmental Education and Sustainable Development* presented on April 10, 2013 at School of Education, Kathmandu University.

Title: Water Scarcity and Its Adaptive Measures: A case study in Chyasal, Lalitpur

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Drinking water is one of the most important components for human survival. Development should address the availability of drinking water facilities because it is still a major problem across many human settlements. Water scarcity has become a lifestyle for the resident of Kathmandu valley. With the increase in the population of the city, water has been a common problem in most of areas. They lack optimum access to drinking water supply. The population keeps on increasing but the water supply provision still remains persistent. The oldest water source – stone spouts have run dry, the piped system is no longer capable to deal with the population growth, and thus bottled water has become the preferred choice as the source of drinking water. Kathmandu, the capital city of Nepal, is facing problems associated with the delivery of drinking water. This study aimed to explore the adaptation of the people to the problem of water scarcity in Chyasal, Lalitpur; the reason behind the existing scarcity and the existing mitigation measures adapted by the local people.

Four research questions were (1) How have Chyasal people perceived the problem of water scarcity? (2) What has been the past trend and present scenario

regarding water availability? (3) What are the major reasons behind existing water scarcity? And (4) what practices are the people adapting to minimize the effects of water scarcity on their livelihood?

To identify the situation on scarcity of water and its adaptive measures, the research was designed from interpretive paradigm using qualitative study. Twenty one people were purposively chosen to represent the population.

The study found that water availability has diminished in the study area leading some of the people to change their profession. This showed a strong perception of the people towards the water scarcity. The study has revealed that dense population, construction of new buildings, and low percolation (infiltration) were some of the reasons behind water scarcity. People were found to adjust themselves differently such as buying water, rain water harvesting, or collecting water through local wells/taps in the community. In addition, the irregular and uneven supply of water by the Kathmandu Upatyaka Khanepani Limited (KUKL) was also one of the reasons to aggravate the water scarcity.

My study draws the attention of the concerned authority (KUKL) to take care of the problem and suggests that the Community based water supply system should be further encouraged.

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Soni Shrestha

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DEDICATION

This dissertation is dedicated to my Aunt Mrs. Bishnu Shrestha and to my Husband Mr. Sanjeev Dahal who continually supported me in my study.

DECLARATION

I hereby declare that this dissertation entitled “Water Scarcity and Its Adaptive Measures: A case study in Chyasal, Lalitpur” submitted to Kathmandu University School of Education, Balkumari, Lalitpur, Nepal, is my own original work done in the form of partial fulfillment of the requirements for the Master’s Degree of Education (M.Ed.) in Environmental Education and Sustainable Development, has not been submitted by any candidate for any other degree.

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I understand that my dissertation will become a part of the permanent collection of the library of Kathmandu University. My signature below authorizes release of my dissertation to those who are interested to study it upon formal request.

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ACKNOWLEDGEMENTS

I would first like to express my sincere gratitude to Asst. Prof. Chhatra Mani Sharma, PhD for his constant supervision, encouraging advice and creative guidance from the early stage of my study. I admire his endurance and patience for answering my confusions and providing constructive feedback and suggestions.

I would like to present my special thanks to Prof. Amulya Ratna Tuladhar, Prof. of Environmental Science and visiting Prof. of KUSOED for his continuous encouragement, academic suggestion and for providing me useful study materials. Likewise, I would also like to thank Mr. Raju Maharjan, Administrative Assistant, for providing materials and support in shaping this dissertation in the present form. Many thanks go to my office staffs for filling in my frequent research absences to complete my study.

I would also like to thank the professors, lecturers, administrative staffs and the library staffs of the Kathmandu University. My special thanks go to my friends Trilochan and Srijana for their cooperation and encouragement. I would like to express my appreciation to all the scholars, friends and well-wishers.

I thank all my research participants and friends specially for supporting me during the data collection process by providing enriched information.

Last, but not the least, I thank my family, for providing their valuable times and moral support during the study and the thesis work.

Soni Shrestha

Degree Candidate April 10, 2013

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ABBREVIATIONS

ADB	Asian Development Bank
CBS	Centre Bureau of Statistics
CS	Country Strategy
CTSC	Chyasal Tole Sudhar Committee
DWSC	Drinking Water Supply Corporation
ENPHO	Environment and Public Health Organisation
FGD	Focus Group Discussion
ICIMOD	International Centre for Integrated Mountain Development
IUCN	International Union for Conservation of Nature
KUKL	Kathmandu Upatyaka Khanepani Limited
MDG	Millennium Development Goal
MLD	Million Liters per day
NG	Nepal Government
NGO	Non-Government Organisation
NHSP	Nepal Health Sector Program
SACOSAN	South Asia Conferences on Sanitation
UEMS	Urban Environmental Management Society
UN	United Nations
UN-HABITAT	United Nations Human Settlements Programme
VDC	Village Development Committee
Yrs.	Years

CHAPTER I

INTRODUCTION

This chapter describes the background information. It includes the problem statement, rationale of the study, purpose of the study, research questions related with the study, limitations and finally the overview of the chapters. The main purpose of this chapter is to explain the readers with the intent of the study.

Background

Water is one of nature's most important gifts to mankind. Water is one of the most basic needs for life, and water scarcity is the most important limiting factors for sustainable development. Nepal is one of the richest countries in world for fresh water resources although many people in our country are facing the problem of drinking water. They are facing the problem of water shortage. They need to spend many hours to get a jar of water. It is mostly happening in the urban areas due to the large number of households and the continuous growth of the population through migration. In developing countries like Nepal, it is somewhat difficult to solve problem even it is great in natural resource. In 2000, about 78% of people living in urban areas had access to an improved water supply within 15 minutes' walk from their homes (WAN, 2005). Inadequate quantity, non-uniform distribution of water, unreliability of supply and high rate of unaccounted for water(due to leakage and illegal connection) are major issues related to water supply in urban areas in Nepal (ADB, 2010, as cited in ICIMOD/MoEST/UNEP, 2007).

Water is the essential component of life. Although Nepal is one of the richest countries in water resources, we are facing adverse effect of water scarcity. Previously

there was less population, so the demand of the people was easily met. There was no problem of water to the people and could freely use the water for various purposes .There was regular supply of water, thus people had never experienced the water shortage but now the situation is not like that, almost all the water resources like river, ponds etc. have been contaminated. They have been polluted, thus people were extremely affected by this problem. Along with this problem, the issue of water scarcity has also become prominent. Nowadays, people need to allocate extra time for fetching water. They need to stay in a queue for many hours to get water and they also need to pay for it even in the stone spouts of the community. Distribution of water was regarded as the good work; it was also believed that if one distributes water, he/she will go to heaven after death but now the people quarrel with each other for water.

Water scarcity has become a lifestyle of the residence of Kathmandu valley. The population keeps increasing but the water supply provision still remains stagnant. The oldest water source – stone spouts have run dry, the piped system is no longer capable to deal with the population growth, and thus jar water has become the preferred choice as the source of drinking water. Anil Chitrakar, culture and environment expert stated that "water stored in watershed areas used to be supplied to the city area through stone spouts in the past, which was well engineered natural system which fulfilled water needs of the people". Many of those stone spouts can still be seen in the city but most of them run dry. Two spouts in Lalitpur Sub-Metropolitan City are the exception since they still are supplying the drinking water to people.

As per the data of Non-government organization (NGO) Forum for Urban Water and Sanitation at present there are 389 stone spouts in the five municipalities of

the Kathmandu valley. These stone spouts are fulfilling about 10 percent of water demand of Kathmandu valley supplying 3 Million Liters per day (MLD) water in dry and 7.7 MLD water in wet season. According to the spokesperson of Kathmandu Upatyaka Khanepani Limited (KUKL) he states there is the 10 percent increase in the demand for drinking water every year. There is demand for 320 MLD in Kathmandu valley alone but KUKL is able to supply only 90 MLD in dry season and 145 MLD in wet season (Adhikari, 2011).

In Patan, there were many stone spouts like, *Chyasal dhunge dhara (stone spout), Alkohiti, Mangal Bazaar Dhunge dhara, Sundhara* etc. The water was clean and hygienic in these stone spouts. People used to take water from the stones spouts and traditional dug wells for drinking and many other purposes. People from different places used to come there to take water and they depended on those stone spouts for drinking water. People also used to use the pipeline water distributed from Drinking Water Supply Corporation (DWSC) for different purposes and depended on stone spouts for the drinking purpose but now all the stone spouts have almost in the dry situation, very little amount of water flows which does not meet the demand of the people. Thus scarcity begins to occur.

So, I focused on the urgent and contemporary issue of water scarcity and how people are managing the issues in terms of adaptation of water scarcity in Chyasal Tole of ward no-9, Lalitpur.

Statement of the Problem

Water has been an important element since the origin of human life. Use of water has been growing at more than twice the rate of population increase in the last century (UN-Water, 2006). People are not getting sufficient water though they are paying high amount. Before 10-20 years, drinking water was not a serious problem in

the study area where KUKL used to supply water daily. The stone spouts were facilitating people with drinking water. However, this source has also been stopped due to the construction of buildings in the surrounding (ICIMOD, 2007).

In addition, the demand of water for household purpose is also increasing. “The daily water demand at present is 320 million liters but the supply is only around 130 million liters. “Said Suresh Prasad Acharya (KUKL spokesman). This huge gap between supply and demand shows the scarcity of water in Kathmandu.

Every individual is suffering from water scarcity, especially drinking water; however, the poor are more suffered (UN-water, 2007).It is a serious problem which immediately needs to be solved for those community people to sustain their lives. Water scarcity is causing many health hazards as well. As a community member, I have also experienced difficulties personally. It is being very difficult to sustain. People are forced to buy the water to meet their house hold needs. It is very essential contemporary issue to study which is also related to the effect of climate change.

As water is a social good, everyone has the right to have easy access of drinking water. But people of Chyasal are facing the problem of drinking waterfall-round the year except during the rainy season. During summer, people take water from stone spouts and tap water and fulfill their needs. But in the winter season, there is the serious problem of water. Water availability in the study area is getting more complicated making water a more scarce resource. Therefore in this research, my main concern was to focusonwater scarcity issue as a central point.

Another objective of this study was also to understand the adaptive measures of water scarcity by the community people.

Rationale of the study

Although Nepal is rich in water resources, its people are neither getting enough water to meet their needs nor availability of clean water. Having been a victim of water shortage, I considered it worthwhile to conduct a research in a way which would address the experiential aspect of this issue. Thus researcher carried out her research on this topic.

Purpose of the Study

The general purpose of the study was to explore the perception of water scarcity and the knowledge on its adaptive measures among the peoples of Chyasal, Lalitpur. The specific purposes of the research were to find out the knowledge and perceptions of people on water scarcity and its effects on human livelihood, to find out the major reasons behind existing water scarcity and to explore the adaptive measures towards the water scarcity.

Research Questions

1. How have people perceived the problem of water scarcity?
2. What was the past trend and present scenario regarding water availability?
3. What are the major reasons behind the existing water scarcity?
4. What practices are the people adopting to minimize the effects of water scarcity on their livelihoods?

Delimitations of the Study

The present study is confined within the defined area, that is, Chyasal-9, Lalitpur, so the findings derived from this study may not be applicable for wider generalization. In this research the respondents were selected purposively within the location.

CHAPTER II

LITERATURE REVIEW

Water and its Scarcity

Building on the definition proposed by Winpenny (1997, as cited in FAO, 2012), the World Water Development Report (UN-Water, 2006) defined water scarcity as:

> *"The point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully [...], a relative concept [that] can occur at any level of supply or demand. Scarcity may be a social construct (a product of affluence, expectations and customary behavior) or the consequence of altered supply patterns stemming from climate change. Scarcity has various causes, most of which are capable of being remedied or alleviated"* (FAO, 2012).

This definition argues that scarcity of water is generated when the supply of water is inadequate or the quality of water is affected. In this regard I am concerned with the supply for domestic and drinking purpose only.

In a study of the relationship between population growth, climate change and water scarcity in south western United States, Fuller and Harhay (2010) pointed out that water scarcity will continue to become a greater stress due to the decline in natural water sources such as glacier melt from climate change and due to increasing population densities. The conflict becomes a greater possibility when one community

diverts water resource at the disadvantage of downstream community for lack of domestic and international water policies.

Importance of water in human life

Although water is the most widely occurring substance on earth, only 2.53 percent is fresh-water while the remainder is salt water (UN-Water, 2006). The central role that water plays for this planet and its inhabitants has often been summed up by the expression 'water is life'. The water that falls from the sky represents, directly or indirectly, the basis for life on earth.

Access to safe water which is also a human right and providing these services underpin human development and health, transforming lives. In Nepal official statistics claims that access to improved water and sanitation services stands at 80% and 43% respectively (Shakya, 2009).

There are different issues related to water. Some of them are general issues, social issues, water supply and sanitation issues, irrigation issues etc. Among them my concern is on water supply issues, which I am connecting with water scarcity and its coping mechanism in the study area. Water supply and sanitation issues include:

- Lack of adequate planning, design and construction of water supply and sanitation projects
- Lack of appropriate approach towards rural water supply system
- Improper management of water supply systems of Kathmandu Valley and other urban Centre.
- Lack of water quality standards published by Govt of Nepal in 2006 (2063 B.S.) for drinking water (HMG/Nepal, 2002).

The output of the Water Resources Strategy is to provide every Nepali with reasonable access to quality potable water and sanitation facilities, as well as to

promote and support hygiene awareness. At present, however only two-thirds of Nepalese people have access to a basic water supply service. The NG has placed priority on increasing water supply coverage throughout Nepal, even at basic levels, over the next five years. Only 67% of population has access to safe, clean drinking water (Sharma, n.d.).

It is said that approximately100 L/day is the minimum amount of water required per person for good health, while water scarcity has received considerable attention in recent decades; water quality issues have been mostly neglected. At present, to my knowledge, a global picture of the water quality situation does not exist. Yet deterioration in water quality is evident in most parts of the world.

Water quality management is a critical challenge in both developed and developing countries.IFS (2003) state some of the facts about the water which are given below.

- Nepal has 225 billion m^3water available annually.
- Only 15 billion m^3water (~6%), has been utilized for economic and social purposes.
- Mainly springs, streams and small rivers are used for drinking water, irrigation and hydropower in hilly area, whereas groundwater is used in Terai belt.
- Only 72% of the country's population has access to basic water supply. By the end of 10^{th} plan, it has been expected to reach 80%.

Water is essential for all socio economic development and for maintaining healthy ecosystem. As population increases and development calls for allocations of groundwater and surfaces water for the domestic, agriculture and industrial sectors, the pressure on water sources intensifies, leading to tensions, conflict among users as well as the excessive pressure on the environment. The increasing stress on the

freshwater resources brought about by ever rising demand and profligate use, as well as by growing pollution worldwide, is of serious concerns.

Water use has been growing at more than twice the rate of population increase. In the last century, although there was no global water scarcity as such, an increasing number of regions were chronically short of water. According to UN-Water (2007), by 2025, 1800 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions.

Different researches have shown that fresh water bodies have a limited capacity to process the pollutant charges of the effluents from expanding urban, industrial and agricultural uses. Water quality degradation can be a major cause of water scarcity. Imbalance between availability and demand, the degradation of groundwater and surface water quality, inter sectorial competition, interregional and international conflict, all bring water scarcity.

There are different causes of water scarcity but the major causes are:

- Over population
- Water pollution
- Climate change

Water Scarcity in Nepal

Nepal is a country in a flux, with state restructuring to incorporate federalism likely to take place. Its economy, which is based on subsistence agriculture, is largely sustained by remittance from India and Middle East. Nepal has a demographically young population of about 29 million (Nepal, 2010), with a median age of about 21years. Urban population of Nepal is growing at a rate of 17%.

According to Nepal (2010), the average life expectancy in Nepal is about 63 years and the average literacy rate stands at 49%.Both child and maternal mortality rates are declining but the risk of food and water-borne diseases remain high, particularly diarrhea and typhoid. The percentage of population below the national poverty line, for example has declined from 42% in 1990 to 25% in 2009. The population with access to improved water source and improved sanitation, particularly the latter, has seen a dramatic increase in the last two decades.

The population growth rate of Kathmandu valley is more than the country's population growth rate. According to CBS (2011) the decadal population growth rate in Kathmandu is 61.23%. People from different parts of the country come to Kathmandu for many different purposes as for education, for employment etc. which leads to the over demand of water and many other things. So the scarcities exist.

Water pollution is the major cause of the water scarcity; nowadays we can see the open dumping in rivers of the valley. The chemicals and other wastes are directly discharged in the river which contaminates the water resources that ultimately leads to water pollution and scarcity of water. Eighty five percent of the water that is released into the rivers is not treated and include hazardous waste of hospitals. With the exploding population in the valley, the water source has become polluted in Nepal (2011).

Water Scarcity in the Urban Areas of Nepal

Depending on their location, communities in Nepal face a different set of challenges in management of water resources. In many parts of Nepal, urbanization results in increased pressure on water resources which is especially true when urban growth rate is poorly managed. In Nepal, the rate of urbanization is among the highest in the South Asia. In dense urban centers water scarcity is a persistent problem

resulting from over extraction and leakage from poorly maintained piped systems. The poor management of waste water threatens the quality of these already limited resources. In this setting, water optimization such as re-uses and treatment technologies are techniques so as to recharge ground water (Nepal, 2008).

In a study of factors relating to urban growth in Siliguri municipal corporation of west Bengal, India, in a journal of geography and regional planning Roy and Saha (2011) pointed out that the rate of urbanization is rapid in developing countries but due to the lack of proper planning strategy various socio economic and environment problems are imposed on the concerned area, a finding closely reflex the situation in fast growing Chyasal area of Lalitpur sub-metropolitan area.

In this section water scarcity in Kathmandu valley will be discussed under following headings as mentioned in Adhikari (2011).

- Dry spouts
- Failed piped system
- Indispensable Jar water
- Unavoidable water crisis.

Dry spouts. Stone spouts have been the oldest source of water which once used to supply clean drinking water to the people of Kathmandu valley. Water stored in watershed areas used to be supplied to the city area through Raj Kulo and distributed to households through stone spouts in the past. It was well engineered natural system which fulfilled water needs of the people. Many of those stone spouts can still be seen in the city, but most of these spouts have run dry. Two spouts in Lalitpur sub- Metropolitan city are the exception since they still are supplying drinking water to people.

Water from the stone spout was more than enough to sustain for people of Kathmandu valley some 100 years ago as the population was 20 times less than that of today.

Failed distribution system. The modern tap was introduced by Bir Shumsher in the 1880s and the first one was named Bir Dhara. Later on the supply of water to household was done through underground piped water, which is still operating. With time, the population of Kathmandu valley grew and construction works over aquifers of stone spouts became rapid. As such aquifers dried up forcing stone spouts to run dry. In a survey conducted by NGO Forum for Urban Water and Sanitation in2011, twenty four places of Kathmandu district and ten in Lalitpur district have not been supplied water for a long time.

Indispensable Jar water. "Once every two days, we purchase a jar of water for drinking purpose. Although our house has connection to water supply of KUKL, we do not get water regularly. So jar water is indispensable to our family"Said a housewife from Naya Bazaar. Her household has been depending upon jar water for drinking purpose for the last two years.

Every day 20,000 to 25,000 jars are supplied in the Kathmandu valley. There is 20 to 40 percent increase in demand for jars every year. Jar water might address the crisis to some extent but it is not accessible to the urban poor as they cannot afford it. If not solved on time, the present water crisis will be a source of future conflict.

Unavoidable water scarcity. As per the record (CBS, 2001 as cited in Adhikari, 2011), there is a 10 percent increment in demand for drinking water every year. There is demand of 320 MLD in Kathmandu valley alone but KUKL is able to supply only 90 MLD in dry seasons and 145 MLD in wet seasons.

Table 1

Access to Drinking Water by Household in Lalitpur District

Tap	Well	Tube well	Spout	River	Others
83.05	09.79	1.20	4.50	0.16	1.31

CBS (2001) as cited in ICIMOD/MoEST/UNEP, 2007)

Table 2

Drinking Water Supply and Demand in Lalitpur District

Description	Lalitpur
Water supply coverage % by DWSC	70
Total city water demand (m^3/day)	19559
Total city water supply by DWSC (m^3/day)	9779
Total volume of surface water supply (m^3/day)	6846
groundwater supply(m^3/day)	2034
Individual extraction of groundwater for domestic purposes (m^3/day)	9779

[DWSS (2004) as cited in ICIMOD/MoEST/UNEP, 2007)

Table 3

Nepal's Progress on Key MDG Indicators

Progress against indicators	**1990**	**2000**	**2006**	**2009**	**2015 (MDG target)**
% of population below national poverty line.	42	38	31	25	21
% of children who are underweight(<5)	57	53	45.2	38.6	29
Infant mortality per 1000 live births	108	64	48	41	34
Maternal mortality ratio	515	415	281	229	134
Total fertility rate	4.6	4.1	3.1	2.9	2.4
% of population with access to improved water sources	46	73	81	80	73

[WAN, n.d.].

Table 3states that 80% of Nepalese have access to improved water sources up from 46% in 1990.But the coverage is only 53% if we consider the functionality of water supply, without even accounting for water quality.

Adaptation to Water Scarcity

Scarcity of water is one of the major global problems at the moment and it is likely to be an ever increasing problem in future. A range of strategies have been followed to adapt with global water scarcity with the help of international agencies and national wise and local wise. Some of them are desalination of saline water, use of waste water, rain water harvesting etc.

Adaptation to Water Scarcity in Lalitpur. Because of the scarcity of drinking water, people had started to adopt different measures to minimize the water problem. In a study of water consumption status in Lalitpur, sub-metropolitan city area of Nepal published in a journal of the institute of engineering Poudel (2007) noted that one third of the water supply was provided by the government, Nepal water supply and sewage corporation with the remaining two third supplied by a combination of private wells, neighbors well, public wells, tanker supply, rainwater harvest and traditional stone spouts of these non-governmental sources, traditional stone spouts supplied the largest proportion at 27%. He also found the per capita water consumption per day varied from29 to 49 litters.

The Lalit Kalyan Kendra School is located in Lohala, ward number 8 of Lalitpur Metropolitan City. Like many schools in Nepal's urban centers, Lalit Kalyan faced difficulties in providing clean water to its 270 students and 14 staffs. When the government services tap went dry 2 years ago, the school began to bring in water from a local tanker services which cost NRs. 1600 (US$ 25) per month. In addition, to the burdensome cost of the tanker, the water was not sufficient.

In 2006, Water Aid Nepal (WAN)'s urban partner, UEMS, assisted the school in constructing a new 32ft. deep dug well at their premises (Nepal, 2008). To ensure that the well provides the sufficient amount of water even during Kathmandu's dry seasons, when ground water level drops, UEMS fitted the well with a system that uses rainwater collected on the school's roof to recharge the well. Recharge system, by diluting the water stored in the well has also been effective in reducing the turbidity and strong iron smell that accompanies Kathmandu's ground water.

For many years the residents of Chocchen, a small, densely settled community in ward number 11 of Lalitpur Sub-Metropolitan city, survived on a piped government supply of water that was sporadic, and often of poor quality .The residence struggled to meet their daily water needs for drinking and sanitation. In 2006, with the assistance of the Water Aid Nepal and the UEMS, the community constructed a new dug well. The well was combined with 25000 liters overhead tanks that are filled each day by an integrated electric pump, after which the care taker distributes water to over 50 households. The care taker, a local resident does this twice a day, ensuring that each household gets 30 minute of equal access per day. While some residents have roof top storage tank, many collect water in the buckets or other vessels until it is needed (Nepal, 2008).

Adaptation in Chyasal. Water scarcity in Kathmandu valley has become synonymous as the capital denizens need to struggle for the every drop of water. Water is very precious because of the acute scarcity. However, a small community of Lalitpur Sub Metropolitan city Chyasal is an exception to this case. They adapted to some extent to the scarcity of water recently. Therefore, the traditional Newar community need not suffer because of water crisis. Self-sufficient in terms of drinking

water, this community is even helping other communities by providing safe drinking water to them plus they have set up a good example of environmental concern.

No drop of water. The residents of Chyasal, Kwayalachi were dependent upon three stone spouts: Chyasal Hiti, Manga Hiti and Narayan Hiti for their daily needs. But not a single drop of water would trickle from these spouts during the dry season causing water scarcity in the households. Some of the households were connected to the water supply of KUKL. But water rarely trickles from those taps too. It would take more than half an hour to fetch water from other localities. People would reach Mangal Bazzar, Khumbheshwor, just in search of drinking water.

Best alternative. The locals of Chyasal started looking for alternative ways to solve their water scarcity. The Tole Sudhar Committee (TSC) of Chyasal in 2005 urged then mayor of Lalitpur Sub-Metropolitan city to solve the water scarcity. The mayor gave a permission to dig a well near Chyasal Hiti to then president of TSC.The locals were excited thinking that their water woes were about to be solved. But the Stone Spouts Conservation Committee (SCC) protested their decision of digging a well near the stone spout. The SCC urged that digging a well would cause the stone spout to dry. But the problem was acute and there was no other suitable place. Further, there were no other ponds and stone spouts below the place where they desired to dig the well. Some believed that the well here would not cause any other stone spouts and ponds to dry. And they were successful in convincing the authorities to get the permission for the well. But the residents of Chyasal were not so lucky because water from the bore well turned out to be unusable due to its high turbidity and high iron concentration.

Water purification. There was water but they could not drink a single drop. To solve this problem the community knocked on the doors of Urban Environment

Management Society (UEMS). The locals established an innovative safe drinking water bottling distribution system in Chyasal. A bio-sand filter was constructed with physical labor from Chyasal inhabitants. The bio-sand filter reduced the turbidity and removed iron from the water and made it drinkable. Now the water from the well is pumped to a 5000 liter sedimentation tank and then pumped into three such bio sand filters. Around 5000 liters of water is filtered every-day and collected in the collection tank where the water is chlorinated before being poured into 20 liters jerry cans and jars for distribution.

End of water woes. After the construction of purification plant, the community set up Gaja Laxmi Drinking Water System (GLDWS). The system collects the contaminated water from the dug well, treats it and distributes it to the local who contributed to the construction of the system at a rate of Rs.3 for 20 liters. Others are charged Rs.5 for 20 liters. Currently the system serves around 500 households every day (Adhikari, 2011).

Review of Empirical Studies

Rain water harvesting and ground water recharge have been advocated in the urban context, but aside from case studies there has been a little empirical research conducted that demonstrates the relationship between recharge, ground water levels and water quality. In this context, during 2008, a research study was being carried out by NGO Forum, with the support of WAN and UN-HABITAT, as well as engaging the expertise of the Central Department of Geology at Tribhuvan University. The research on recharge of ground water (Shallow Aquifer) by harvesting rainwater aims to examine the suitability of four different recharge methods in the Kathmandu Valley: recharge through dug well, recharge through soak pits, recharge through soak

pits with bore wells, and recharge from surface using infiltrometers (UN-HABITAT, 2008).

Through piloting and recommendation of the research study this program aims to demonstrate the link between recharge, ground water levels and water quality within Lalitpur Municipality (Nepal, 2008).

Paschim Paaila (2011) conducted a survey research on "Situation of water, sanitation and hygiene condition in Chyasal". Research was conducted in 165 households, where 881 individuals were surveyed. The survey was carried out using the quantitative research method. The residence of the site of all family was surveyed by the administration of structured questionnaires. The priority of the study population was the head of house as a respondent. The household survey was mainly focused on the situation of water, sanitation and hygiene condition and the status of the youth in the community.

The entire research showed that the availability of water was not sufficient. The table given below shows the sources of water for different purpose and figure shows the availability of drinking water and purification of water in Chyasal Tole.

Table 4

Sources of Water for Different Purposes

S.N.	Sources of Water	Purposes			
		Drinking (%)	Cooking (%)	General use (%)	Toilet (%)
1.	Private Tap	77.6	75.8	66.7	67.3
2.	Public Tap	4.8	5.5	4.2	4.2
3.	Neighbour's Tap	6.1	6.7	4.2	3.6
4.	Private Well	0.6	0.6	6.7	7.3
5.	Public Well	4.2	6.1	12.7	13.3
6.	Jar	6.1	2.4	1.8	1.2
7.	Spout	-	-	-	-
8.	Tube well	-	-	-	-
9.	Tanker	0.6	3	3.6	3
Total		100	100	100	100

Source: Paschim Paaila (2011)

According to the table 4, majority of individuals were using water from private tap for different purposes. For drinking, water from neighbour's tap and jar water was mostly used after private taps.

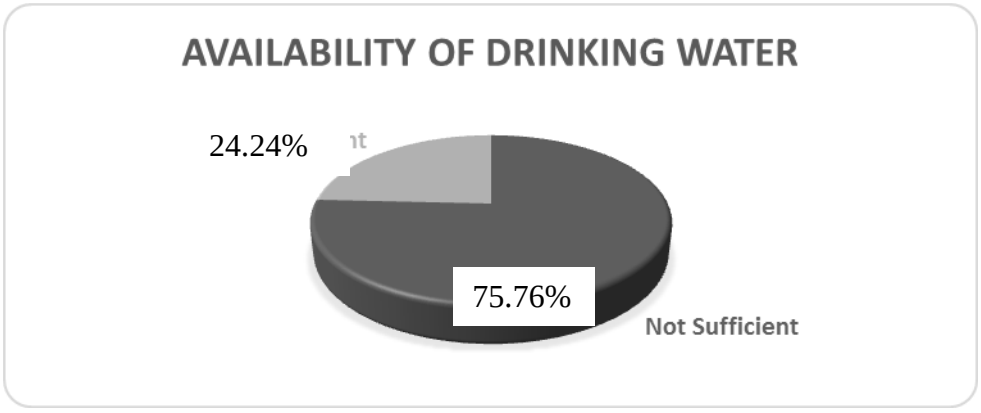

Figure 1. Availability of drinking water (Paschim Paaila, 2011)

Figure 1 had shown the availability of drinking water in Paschim Paaila (2012)'s research where there were only 24.24% sufficient and 75.76% not sufficient

water for drinking. So this can be said that, there is no sufficient drinking water in Chyasal Tole. Figure 2 given below explains about the water purification.

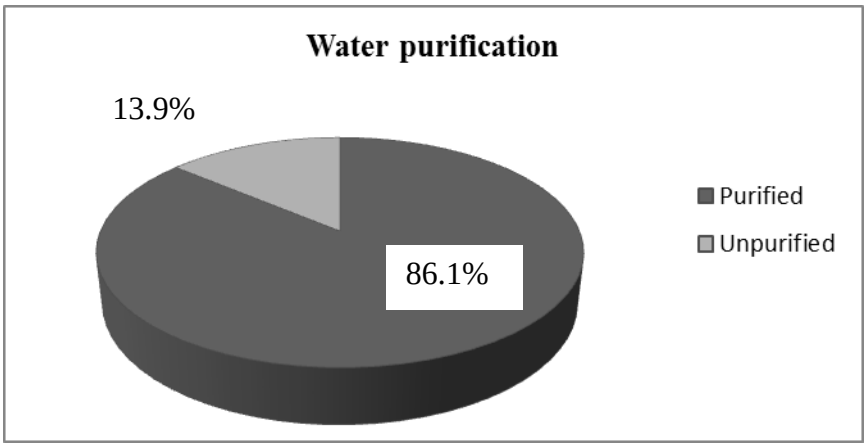

Figure 2. Water purification (Paschim Paaila, 2011)

Figure two indicates that the most of the individuals purify water before using it.

Policies related to sanitation and drinking water:

There have been developed many policies regarding drinking water and sanitation. Some of the policies such as national policy, Rights and Laws of drinking water and sanitation, Existing conditions of Drinking Water and Sanitation in Nepal, National policy on drinking water discussed were presented below:

National Policy

National and International Commitment for Sanitation and Drinking Water:

- Nepal aims to achieve an equal and basic access to all in drinking water and sanitation by 2017.
- As Nepal has committed in Millennium Development Goal (MDG) that by 2015 there must be access to drinking water and sanitation by 73% and 53% respectively.
- Based on NHRC (2009), major Acts and policy documents guiding the development of water sector in Nepal are the Water Resources Act (1992), Water

Resources Regulations (1993), National Water Supply Sector Policy (1998), Drinking Water Regulations, and the Ninth Plan (1997-2002). The Water Resources Act (1992) gives the highest priority among competing uses for water to drinking water and domestic use.

Rights and Laws of Drinking Water and Sanitation

According to NHRC (2009), rights and laws of drinking water and sanitation are as follows.

- United Nations General Assembly (2010) has declared the drinking water and sanitation as the HUMAN RIGHT.
- Water Act (2049) has given the first priority of having drinking water.

Existing Conditions of Drinking Water and Sanitation in Nepal

- Only 8o% Nepalese has access to drinking water, rest 56 lakh people of Nepal have not an access to drinking water.
- To obtain the National goal by 2017 of making accessible of drinking water and sanitation, Rs.7.5 billion is needed annually (Nepal, 2011).

One defining feature of the country strategy (CS) is two big targets: the Millennium Development Goal (MDG) targets of 2015 to ensure 53% of the population has access to improved sanitation and 73% has access to improved water sources and the nation target of universal access to water and sanitation by 2017.

The government of Nepal has signed up to the MDGs, under which it needs to achieve73% drinking water coverage by 2015. It has also declared that it will achieve universal access to water by 2017.Nepal as the signatory to the South Asia Conferences on Sanitation (SACOSAN) committed to water and sanitation as the basic human right (Nepal, 2010).

Table 5

Water and Sanitation Budget, Government of Nepal

Decade	1970s	1980s	1990s	2000-2009
Water and Sanitation expenditure in US$(millions)	28	130.8	256	488

(WAN, n.d.)

Environmental Policies

The National Urban Water Supply and Sanitation Sector Policy (2009) mentioned that there are cross sectional policies that impinge on water and sanitation such as the National Urban Policy (2007), the Local Self Government Act (1990), and the Nepal Health Sector Program II (NHSP-II) (GoN, 2009).Many of these policies highlight the importance of demand –side management by communities, as well as the involvement of the private sector. On paper Nepal has the policies it needs to deliver universal access for all. What is lacking is the political will, both at the government and the sector level, to drive the work on water to meet the MDGs and National goal (Nepal, 2010).

Patan (the study area)

Ward no. 9 of Lalitpur district, popularly known as Patan, is considered as the oldest among the three cities within Kathmandu Valley. The city spread in 15.46sq.kilometer and divided into 22 wards and is inhabited by 466784 people (CBS, 2011) Lalitpur Sub metropolitan city is located in the central part of Kathmandu valley. It is bounded in the Northwest by Bagmati River, in east by Karmansa River, in South by Sunakothi, Dhapakhel VDC and Nakhhukhola. The annual growth rate of Lalitpur district is 3.23% whereas the national growth is about 1.35% which is lower than the district annual growth rate by 1.88%. (CBS, 2011)

The Bagmati forms the common boundary of Lalitpur sub-metropolitan and Kathmandu metropolitan. Nakhhukhola forms the boundary between Sainbhu VDC and Lalitpur sub-metropolitan. According to the (CBS, 2011) the Lalitpur district has 114443 households, with the total population of 466784 (237114 males and females 229670). And the absent population is 23790. The population density is 1212 people per square km.

The ward number 9 lies to the north-east part of the Lalitpur sub-metropolitan city, south of Manohara and Bagmati River. This ward has many Toles like: Chyasal, Khanpinche,Lohla,Bholdhoka,Balkumari,Gachhen,Gahiti,Ombahal,YampiBihar,Walachhe,Chikanbahil,Bailachen,Kobahal,Dhumbahal,Sankhamul, etc. According to the CBS (2001) data, the ward has 1706 household, with the total population of 8135(males 4447 and females 3688). The population density is 105persons per hectare. This ward is predominantly resided by Shrestha, Maharani, Byanjankar, Awale, Mongol and Shah Castes.

Table 6

Vital Statistics of Ward No. 9

S.N.	Description	Populations
1	House Hold	1706
2	Total population	8135
	Male	4447
	Female	3688
3	Population Density	105.34

(CBS 2001, as cited in Bhattarai et al., 2005)

Theoretical Review

In this section I have described the theories that are related to my research.

Socio Ecological Theory

"Social ecology" means to view the social sphere in its relations to its environments (Opielka, 1996). Socio-ecological theory focuses on the interrelationship of society and environment. More specifically it is concerned on how the society degrades the environment and how degraded environment affects the society (Parajuli, 2010). The mission of social ecology is the interdisciplinary analysis of complex problems of contemporary society which occur in the social and physical environments (Whitely, 1999).

According to Whitely (1999), the core principles of socio-ecological theory are as follows:

- Identify a phenomenon as a social problem
- View the problem from multiple levels and methods of analysis
- Recognize human environmental interactions as dynamic and active process
- Understand people's lives in an everyday sense.

Social ecology serves as the theoretical framework for my research since the perception and response to water scarcity in community is a complex interaction of social processes and ecological processes in one unitary system. For instance, the empirical fact of water scarcity is perceived and responded differently along different social parameters such as age, gender, literacy and geographical location.

CHAPTER III

RESEARCH METHODOLOGY

In this section I have discussed the theories related to my research. Since my research is a case study based qualitative research, I have discussed elements of my research paradigm such as, ontology, epistemology, axiology, research design, quality standard and ethical consideration.

Research Paradigm

Paradigm is a comprehensive belief system, world view or framework that guides research and practice in the field (Willis, 2007). Among different paradigms of social science this research is guided by the 'naturalistic paradigm' of Lincoln and Guba (1988, as cited in Armitage, 2007). Interpretivist considers that there are multiple realities (Denzin & Lincoln, 2003). Reality differs from person to person. Thus in this research I had tried out to identify nuances regarding how water problem is perceived and adapted with in Chyasal.

Ontology

Ontology is about the form and nature of reality or society and is concerned with the questions how they are and what they do (Parajuli, 2002, as cited in Bajracharaya, 2009). So far my study is concerned, I believe in getting multiple realities by using different strategies. In my study, I have added the observation about the attitudes while listening to responses on how water scarcity is affecting the people and what people are doing to minimize those effects.

Epistemology

Epistemology is the study of knowledge. Knowledge is personal as well as subjective as suggested by Cohen et al. (2001).Knowledge is softer, more subjective, and spiritual or even of transcendental kind, based on experiences and insights of a unique and personal nature. Knowledge or meanings or realities are constructed through interaction between individual and the world. In this research I tried to find out how the people understand the water scarcity and how they were adapting to it. Creswell (2003) mentioned that constructivist researchers address the processes of interaction among individuals. The personal and subjective knowledge or experiences shared by the individuals guided me to obtain the conclusion on how actually water scarcity is understood and how they were adapting to it.

Axiology

Axiology is "theory of value" Creswell (2003). Axiology is the science of how humans value things and make value judgments. To value is to think, to assign meaning and determine the riches of properties. Values are humanly created, softer and personal which can be selected from wide range of recent and emerging technology, like participant observation. Cohen, Manion, and Morisson (2001) write that the individual creates, modifies and interprets the world in which she/he finds her/himself. Hence the participant's experiences on water scarcity and adaptive measures on it were interpreted and analyzed to derive the conclusions which are the excellence of this research.

Qualitative Research

There are three main methodological approaches in research, viz. qualitative, quantitative and mixed. In my research, I used qualitative approach. Qualitative research tries to explore the meaning, values, experiences, perceptions of other

people. A qualitative study is a process of inquiry, which has aim to understand social problems from multiple dimensions. As qualitative research uses naturalistic approach that seeks to understand phenomena in a context of specific settings as location, caste, gender, age etc. considering it as real world settings where the researcher does not manipulate the phenomenon of interest (Patton, 2002). This dissertation was carried out in the form of an interpretive case study. So, I tried to explore how the people are adapting with the water scarcity in their daily life. As a qualitative researcher, I was more familiar with the study area and also became aware of developing the friendly rapport with the respondents to see the answers of my queries.

Central to the case study, qualitative research explores people and their experience of reality in order to understand how those people perceive things and how they construct the meaning. Qualitative research also studies the people in the contexts of their pasts and the situations in which they find themselves. I tried to make connection with my study by understanding the situations in the past before facing the water scarcity and now in present after being a victim, what the alternative options people have adapted to minimize the problem.

Qualitative research involves findings of what people think how they perceive and explore attitudes, behavior and experiences through such methods as interviews or focus groups. It attempts to get an in-depth opinion from participants but quantitative research quantifies data and generalizes results from a sample to the population of interest. Qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions (Myers, 2009).

My research questions were based on exploration of experiences of people, their perceptions on problem of water scarcity what they are facing at this moment

and some of the adaptive measures which need discussions and interactions with the respondents which was only possible through the qualitative research.

Therefore using qualitative research helped to collect the different people's view on the water scarcity and its adaptive mechanisms. Different people have adapted different techniques to minimize the effect of water scarcity. So using qualitative paradigm, I could obtain subjective knowledge on how they are adapting with. Since I believe in subjective and multiple realities, I used qualitative research methodology in order to construct information.

Research Design

Research design, simply means measures for collecting, organizing, analyzing, interpreting and reporting data in research (Best & Kahn, 2007; Creswell, 2003). Research design helps to adapt different data collection tools and inquiry strategy. It also helps to draw upon the key findings of the research, appropriate data analysis and discussion on the findings.

Case study method enables researcher to closely examine the data with a specific context, case study in their true essence, explore and investigate contemporary real life phenomenon through detailed contextual analysis of a limited number of events or conditions and their relationship (Zainal, 2007). The case study is a way of organizing social data for the purpose of viewing social reality (Best & Khan, 2011). Yin (2003) defines a case study as "… an empirical inquiry that investigates a contemporary phenomenon within its real life context. Thus, through the research I have tried to investigate the contemporary issue of water scarcity and how they are adjusting the problem in their daily life.

Unit of Analysis

In order to study water scarcity and its adaptive measure, I have chosen a community of Chyasal, Lalitpur sub metropolitan city as my focus of study. Within this community focus my units of analysis were the users of water. Since there were a lot of variations among these units in terms of location and age, I chose respondent purposively.

Study Area and Study Population

Lalitpur covers a large area of 385 square kilometers. Lalitpur district consists of 22 wards, among which my study area was ward number 9, which includes many Toles like; Chyasal, Bholdhoka, Kyoalachi, Bhelachen, Chikanbahal, Bhindhyo,Lachi etc. The study area of this research was limited within Chyasal.

Respondents

In this research the respondents were purposively selected. Purposive sampling is the non-probability form of sampling, the main goal of this sampling is to sample the participants in a strategic way, so that those sampled are relevant to the research questions (Bryman, 2009).The logic and power of purposeful selection was to select information rich cases for in-depth study (Patton, 1999). So, I intentionally selected my respondents for their views during the focus group discussion and interview.

Altogether twenty one people were selected for the study as major respondents. Out of twenty-one respondents, twelve were taken as the member of Focus Group Discussion. Among them six members were from Upper Chyasal FGD and six members in Lower Chyasal FGD. Five respondents among the remaining nine respondents included: the chair person and the advisor of the *Chyasal Tole Sudhar Committee*, the old aged respondent above sixty years (to collect her lived

experience), young lady below twenty five years (to know about the present situation), and an NGO representative working in Chyasal. Similarly, the remaining four respondents include housewives, two from the local house owners and two from the tenants. In-depth interviews were conducted with all these eleven respondents. For the convenience of the study the respondents were categorized or named as R1, R2 to R8. The details of the respondents were given in the appendix.

Data Collection Techniques

Research techniques were designed for the collection of certain types of information. Qualitative research approach as a case study was followed for the data collection where multiple techniques of data collection were used. Qualitative research uses exploratory aspects and case study helps to draw the experiences and perceptions of people on water scarcity and its effect on peoples' daily life and their adaptive mechanism applied with the water scarcity. As Creswell (2003) mentioned qualitative research takes place in natural setting and uses multiple methods that are interactive and humanistic. Best and Kahn (1998) stated that "Qualitative methods consist of three kinds of data collection: in-depth open ended interview, direct observations, and written documents" (p.184). Based on Ritchie and Lewis (2003) the main qualitative methods include observation, in depth interviews, focus groups, biographical methods such as life histories and narrative analysis of documents and texts.

In-Depth Interview

In qualitative research, in-depth interview is done to reveal people's perceptions, knowledge and experiences on certain theme or phenomenon. I followed in-depth interview methods to expose the experiences of people on water scarcity and its adaptive measures by following unstructured questionnaires.

Open ended questionnaires were developed and interviews were acquired from the people to know the knowledge, and to find out the adaptive measures of water scarcity. Two members of the *Tole Sudhar Committee* representative, working in the study area, were interviewed in detail. Different set of questions were prepared and used for acquiring the information from the respondents.

Focus Group Discussions

A focus group discussion is a cautiously planned conversation designed to achieve insight on a defined area of interest in an open-minded environment. Focus group discussion was mainly used to find out how the people were experiencing or facing the drinking water problem, what were their experiences on water scarcity and how they were adapting with that problem.

Observation

Observation is screening the world through the eye and interpreting the seen things from researcher's feeling. I used observation tool to confirm if the respondents missed any important things during the interview and FGD. Observation allows gathering data on the physical setting, interaction setting and program setting (Cohen, Manion, & Morison, 2001). In my study, observation was done to capture the existing problem of drinking water.

It is important to make personal observation of the attitudes and nature of the respondents' answers to my question to triangulate, verify and nuance the degree of water scarcity problems and how they are coping with them. In my preliminary survey, I observed that their attitudes ranged from belligerence and scorn to helpful cooperation and enthusiastic hope of new solutions from external parties like the government and NGOs.

Data Analysis

The data collected from the field were first transcribed from rough diary into the copy, and it was translated into English from Nepali and Newari. Then the data collected from the field were edited (inspecting and correcting).Then I categorized the data into respective themes according to the research questions and analyzed all the information from participants and understood their views.

Quality Standards

In qualitative research, instead of reliability and validity, the word credibility, neutrality or conformability, consistency or dependability and applicability or transferability is to be the essential criteria for quality measuring (Guba & Lincoln, 1994).Credibility is an attempt to make the research trustworthy or to make the research findings believable from the perspective of the study participants. In my study, credibility was built up through extended engagement in the field and constant observation. Further have included detailed descriptions of the study area and the participants. For further credibility I crosschecked quantitative information with related research data at municipal and national level. Thus, credibility, and transferability provide the lenses of evaluating the findings of a qualitative research (Hoepfl, 1997, as cited in Golafshani, 2003).

Similarly, the term dependability is used in place of reliability (Lincoln & Guba, 1985), that is, the degree of uniformity over time and over similar samples. In my research, dependability was confirmed by developing interview schedule with reference to research questions. I maintained the dependability of the respondents' perceptions and adaptive strategies by the information with other multiple data sources such as municipal level studies in the area, my own experiences growing up

in the area and my vigilant observations regarding the nuance of the attitudes demonstrated.

Ethical Considerations

In my view, ethical considerations play important role in conducting any type of research. While conducting any type of research, it is important to establish boundaries about what can and cannot be written. Honesty is vital; as a researcher I notified my respondents about the objective of this research and about the type of information I wanted to collect from them. I also assured them that their names and any other kind of information would not be disclosed to the third party without their consent. McNiff (1992) says, “Do not reveal the real name of people or place unless you have specific permission to do so. Do not give participants’ fictitious names: those names may belong to other people somewhere” (p. 3).

CHAPTER IV

FINDINGS AND INTERPRETATION DATA

I have used socio ecological theory to outline my findings and interpretation. According to socio ecological theory, the problem of water scarcity is a problem of multiple truths depending on multiple perceptions. This is demonstrated in the discussion of people's perceptions towards water scarcity.

Socio ecological theory also accepts certain ground reality independent of people's perceptions. For instance, I have discussed how groundwater availability changes with underground flow pattern from upper to lower Chyasal and also the ground reality of increasing population density resulting in less water available per capita.

Theme One: People's Perceptions towards Water Scarcity, Past Trends and Present Scenario of Water Availability in Chyasal

To explore the perception about the existing water availability in Chyasal, the responses of the participants depicted that, even in the same Tole, the perceptions about the availability of water are varied. And similarly, the perceptions of the people also differed from each other as follows:

The responses from the R7 and R8 respondents were similar.R7 stated, "The rainfall pattern in this area is being changed. In past, we could cultivate our land in time, we did not need to get worry for water for any purpose, and we usually used to complete the cultivation in the month of May; and latest by the mid of July. But at present, we complete the paddy cultivation by the end of August only. Four/five years ago there was no rainfall till the month of mid-August. We had to cultivate the paddy

by using the tanker water in the field. I think this is because of construction of cemented building and concrete surroundings all over the compound. This situation did not allow the rainwater to be absorbed by the ground and prevented the ground water from being recharged. As a result we are facing the water problem. One of the prime problems of our Tole is the scarcity of drinking water and water for other household uses. We aren't getting sufficient amount of water to carry out our daily activities. The KUKL, one of the main water suppliers of drinking water in Kathmandu Valley, could not fulfill the demand. At the same time, KUKLwater supply pattern is not regular and reliable. We cannot depend on KUKL for the water supply. One more reason for insufficient supply of water in the study area is that it lies in the backside. All the supplied water goes to the front side of the Tole and did not reach to us."

R8 further added that, "the absolute scarcity occurs in the months of December to May. During these six months, we have to face many difficulties regarding water. And the remaining six months, that is from July to November, due to rainfall, the stone spout starts to flow. In addition, the water levels rise in the wells. And those who have wells in their vicinity feel little easy than in absolute scarcity. But these sources are not sufficient. We need to buy well water for drinking as well as other household purposes."

R1 revealed that," in the past, before fifty years there was less population in Chyasal, so even having the less amount of water from the stone spouts and not having the piped water from KUKL, we never needed to worry and purchase the water neither for drinking nor for household purposes. But now the situation is not same, the population is very larger than before and the water resources also started to dry. Nowadays, the untimely rainfall, drying up of the water resources, growing

population and inefficient water distribution are the major causes of water scarcity. Due to the diminishing water supply from the KUKL and the drying up of the stone spout, I really felt the water scarcity. In the past I used to fulfill all the water need from the stone spout, there was easy access of water. But now the water supply from KUKL is not regular and in some of the houses as mine only once or twice a month. We used to get water, which was also only for the half an hour to one hour. And again in the middle of the supply, we used to get contaminated water, so we must be very careful while fetching the water. Thus, we were suffering from water problem.

R2 exposed, "The rainfall pattern has changed, the stone spout became dry, and the water supply from KUKL also gradually reduced. Before twenty years, when I was a child, I used to go to stone spout to collect water in a small pot. I also used to take bath in that stone spout. Due to reduced amount of water, I now feel the scarcity of water. I am getting water once a week that is once in 5 days. This is really very difficult to manage. The KUKL is being irresponsible towards their duty. The water supply pattern is not regular and not sufficient to fulfill our needs. Water from KUKL, which we collect once in 5 days, must be saved for drinking purpose as much as we can. In the meantime, the water supplied from KUKL is very contaminated and not drinkable. So I need to be very alert while taking water."

R6 said, "3 or 4 years ago, there was easy availability of water throughout the whole year. The less supply of water was felt once in the month of May. I came to know that the water supply in this community reduced because of altering the water flow to the Pharping for the paddy cultivation. Due to this activity, I feel less availability of water during this month each year. The water availability was sufficient and I never felt any difficulty to get water. At present, I am getting water from KUKL once in five days for two to three hours. Still, the availability of water from KUKL is

very sufficient to me for all purposes. I use 10-12 liters of drinking water per day and 100-150 liters of water for other household purposes. I am using only one source of water that is tap water from KUKL which is sufficient for me till now. So, I have never thought of any alternatives to meet the water needs."

R4 exposed, "There is absolute scarcity of water. I have got the pipeline of water from KUKL. I get water once in 5 days. Large no. of family live here in this community. So every family gets one to two Jar of water daily. Until or unless the house owner gets water they need, the tenants do not get water."

R2 told, "Here is less availability of water. I am getting water once a week that is once in 5 days. This is really very difficult to manage. The KUKL is being irresponsible towards their duty. The water supply pattern is also not regular and not sufficient to us to fulfill our needs. The water from KUKL, which is collected once in 5 days, must be saved for drinking purpose as much as we can manage. R1 says, "The water availability depends upon the season. In the month of July and August, due to the rainfall, we get sufficient water from stone spout. But during other remaining months, we are in the scarcity and we are in very difficult situation to get water".

"Now the stone spout dried, it is all because of the human activities. People constructed houses, and they made concrete compound which does not let water percolation by the soil. It leads the reduction in groundwater level. Each individual started to dig the well by which the water source divided. The stone spout, which used to flow with the big volume in the past, has become dry in the present situation. The water supply pattern of KUKL is also very irregular. We aren't getting sufficient water from KUKL. We are getting water once in five days, sometimes in ten days and sometimes in fifteen days. The water supply from KUKL lasts just for fifteen to thirty minutes each time. In the past, we used to depend only on stone spout for all water

needs". She further adds, "we are also getting little amount of water in the month of November and December from KUKL. This water is only enough for the drinking purpose and we are managing it with much difficulty."

R5 said, "The water availability was satisfactory. But nowadays it is reducing gradually than in the past. The water availability started to decline from last ten years. Here in the Lower Chyasal, we have scarcity of water only for the month of May; and remaining months we have adequate water for everything. This scarcity is mainly due to the paddy cultivation in Pharping. The farmers of Pharping divert our water supply for irrigation. So in those days we have less availability of water and we are forced to buy water for drinking. We also use stored water for the household purposes."

"I am getting water from KUKL once in five days. KUKL supplies water for two to three hours. I use electric pump so that I could have enough water to use and store. Till now I have sufficient water for all purposes. In addition, I give drinking water to other people of Upper Chyasal and Lower Chyasal. I have got four members in my family and we need 1-12 liters of drinking water and 200-300 liters of water for other household uses."

R8 exposed, "The water supply pattern of KUKL isn't punctual or regular. We are getting the limited amount of water just once a week and that is also only for15 minutes to one hour. Very stinky (dirty) water flows in between the water supply. If the people are not alert while taking water the whole water in the tank becomes contaminated. Thus the KUKL does not meet the water supply demand as well as the quality."

R3 exposed," Water flows sometimes once in five days, sometimes in ten days and sometimes in fifteen days; and that lasts just for fifteen to thirty minutes each time. Sometimes the supply lasts only for an hour which is very rare case."R4 says,"

The house owner does not care about the problem of water scarcity of the tenants like me. They are only concerned about the timely payment of the rent. They generally face the challenges as: - pay water tariff in time, loose time in quarreling with others to get just half ajar of water. The people do discriminate according to caste and place. We sometimes stayed for hour in queue but returned with empty jar. This is really very embarrassing and bitter moment for me. Sometimes, I used to cry with the situation and the behavior of people towards tenants. The water from KUKL is used only for drinking purpose. When it is unmanageable (or when the KUKL water isn't enough), we were compelled to drink the well water which whenever prefer for drinking purposes. In addition, we need to pay for ground waters from the wells for other household purposes. Although we pay the water tariff, they do not supply enough water. The water tariff is also different for local and others. This is really embarrassing to us. Many times we stood in a queue for hours but we did not get water as it ran out.

According to R5 and R6," we do not have such absolute scarcity of water. Sometimes we also feel scarcity which is very less in comparison to the condition in Upper Chyasal. However, some of the houses in Lower Chyasal feel scarcity due to less supply of water from KUKL. In such cases, we used to provide water to them."

While interviewing the respondent about the past trends, R2said, "previous days were very good days when we used to get enough water and I dream to go back to those days again. There was abundant water for everything. It was merely 15-20 years ago when we did not feel any problems and scarcity of water. She further elaborated, "12-13 years ago, water became less available but it was manageable. The absolute scarcity of water has been felt forth last 6-7 years only."

In their opinion, the reason behind the scarcity was population growth, lack of proper utilization of water consumption pattern, lack of regular maintenance and replacement of pipeline. In addition, the water pollution, rapid urbanization (that is constructing new buildings) and the week monitoring/inspection from the government were considered as other causes of water scarcity in the region by her. She further shared that, “In the absolute scarcity period, I used to go to relatives to take bath and wash clothes. I had started to reuse the kitchen water in other purposes such as watering plants, flushing toilets etc. I had used plastic glasses and plates in the parties instead of dishes so that I could save water and to use it for another purpose.”

R8 stated, “There was not such kind of situation about15-20 years ago. The condition was good50years ago as well. The scarcity began only ten to twelve years ago. And the complete scarcity began just before five/six years ago. In the past, there was not any problem regarding water. Everyone could get enough water as much as they need. The stone spouts used to flow for twenty four hours with very large amount. It just used to take five to ten second to get one jar of water. Nobody needed to stand in a queue, nobody needed to quarrel and there was no need to pay money. People from various places used to come there to take water; and all was free of cost. At that time, the water supply pattern from KUKL was also regular. Water used to flow in the alternate days. So there was not any problem and difficulty regarding water. At that time, people of our Tole used the KUKL supplied water for the household purposes only. They never used KUKL water for drinking purposes. For drinking water they totally depended upon the stone spouts, which also could meet the demand of the people.”

According to the explanation of R6,”Ten years ago, people used to get sufficient water from stone spouts for everything. All the people used to depend upon

stone spouts until before six/seven years. The scarcity arose since then and people started to suffer. Before four/five years, KUKL used to supply water in as its alternatives. I was totally unaware about the existence of CTSC and its works."

R7said," there was abundant water before 30-35 years. We used to get abundant water from the stone spouts. In addition, we used to get water daily from KUKL in the past. So we never needed to face any problems regarding water. Our stone spouts had such an abundant water supply that the people from other places used to come over here to get water. But the present situation is different from a decade ago. Water scarcity started in this Tole from last eight to ten years which reached to its maximum (present situation) only before five to six years. The situation had not improved since then; and the Tole still faces this problem. Now, the stone spouts are dried out that have affected many people directly."

R3 exposed, "30-40years ago, there was abundant amount of water. There was not any problem of water for anything. The single stone spout was enough for the whole community or Tole to fulfill our needs. We never needed to get worried, pay time, quarrel to others and spend money for social good that is water. After getting connected to the water pipeline system of KUKL we used to get sufficient water from the KUKL. We never needed to use machine to pull the water. The scarcity began only from before eight to nine years. Recently, the stone spout has dried and the scarcity of water went very high and reached its maximum."

According to R4, "20 years ago, there was enough water for the people. We used to get drinking water and other household water very easily. We did not need to worry for losing time, pay money, and quarrel with others for water. People used to visit our Tole to take water. The water supply from KUKL was also enough. It used to flow daily in the morning and evening both time for two to three hours. We didnot

need to use motors/machine to get water from the pipelines. Since 2058-59 B.S., the availability of water is declining and we were facing a little problem. However, since 2062-63 B.S., the water availability was drastically decreased. Our scenario is changing at present because we are losing harmony in the society as we started quarreling with each other.

According to R5, "30-40 years ago, there was no scarcity, so there was no difficulty to get the water. All the water demand (or the requirement) of our locality was fulfilled by the stone spouts. The stone spouts were enough to fulfill the water need. Similarly the water supply from KUKL was also good at that time. People from other locality also used to come in our waterspouts to collect water. Till 2060 B.S., we were unknown about the scarcity of water.

Summary of the Analysis

From the above responses it can be concluded that the problem of water scarcity for drinking and household purpose was perceived all over Chyasal but more in upper Chyasal.

Chyasal people perceived that such scarcity could be due to change in rainfall pattern (ranging from global climate change to local micro environmental change, due to increase in concrete houses and road surfaces) and water supply pattern of KUKL (complaining about irregularity, turbidity, sewage mixed and drastic reduced hours).

R1 happens to be an old lady having a lifetime of experience and was also a victim of the present water scarcity. R1 insisted that even not having the piped water supply and individual water tap, drinking water and water for other household purposes was not the material of problem. Water was taken as the social good which people need to share as much as possible to others. In contrast now, water has become

the biggest problem and challenge to the people so, taking worries, spending time and money, quarrelling with people is becoming the practice.

R2 a local young lady of Upper Chyasal had insisted that the present situation of water availability was worst. In search of water, she had to roam around the relatives and neighbors. Due to insufficient amount of water, she was compelled to adopt the alternatives to fulfill the water needs. Nowadays she was buying jar water, tanker water and well water to fulfill the water need. She was forced to use less water, and to reduce the frequency of taking bath and washing clothes as well.

The water supply from KUKL is irregular, unsystematic and also contaminated which only lasts for 15 to 20 minutes to half an hour each time. Managing water really became a very big challenge. There was adequate amount of water in the month of June/July due to rainfall and availability of water from a stone spout. Rest of the months, there was inadequate amount of water.

This response of R1 on past trends was also shared by FGD members of Upper and Lower Chyasal, similarly R3 and R6 also. They revealed that they used to get adequate amount of water in the past for all purposes. Furthermore she added that she could do all agricultural activities as paddy cultivation in time.

Almost all the respondents have agreed the major reason behind water scarcity was due to population growth. Since the population of Lalitpur district in 2001 was 3, 37,785 and with a dramatic increase of 1, 28,999, it reached 4, 66,784 in 2011(CBS, 2011). So the growing population needs water in large quantities which the major water supplier of Kathmandu KUKL was not able to meet, hence the people were facing a shortage.

Similarly respondents R1, R2, R4, R7 and R8 further added that due to the untimely rainfall pattern, constructions of the new buildings, roads or because of the

developing concreting the compounds leads to reduction in groundwater level which also increase the scarcity level, among the people. These responses were shared by all the FGD members of Upper and Lower Chyasal as well.

Theme Two: Measures Adopted by the People to Live in Chyasal to Minimize the Water Scarcity

According to R2, in his own words, “I started the rainwater harvesting techniques which I never had done in the past. I am using this technique for last eight/nine years. I was compelled to learn this from the situation and. I collect water in some buckets and drums of two hundred liters. I have six such drums which I use to collect rainwater. I use the harvested water for different purposes like: washing clothes, cleaning dishes, flushing toilets, watering the flowers etc. Because of the lack of the reserve tank, I also collect water in the tank of 500 liters which I use in need. I wish I could dig a well in my own premise. However, I could not do so due to lack of land or space. Therefore, I am forced to manage water according to the availability.”

R1 exposed that, “I dug well by assuming that it will minimize my water problem. Unfortunately, the water from dug well is not drinkable. It is not even fit for other household use. I have to filter it because the color of water is very yellow. Similarly, the level of water is low so that it is not enough for the household use at all. Since water from dug well was not sufficient, I started to harvest rainwater in my home. I learned this technique from the “MAHILA SAMUHA”. Technical personnel from the Lalitpur municipality came to our place and gave training and ideas on rainwater harvesting techniques. So I started to store the harvested water in the reserve tank with a capacity of two thousand liters (2000 liters). I do not need to worry for water if the rainfall occurs regularly. But the problem appears again when there is long term drought.

R1 further elaborated, “The stored water is enough to me for 2-3 months for the household purposes. Anyhow I have been managing water till now for the household purposes; sometime by using the rainwater, sometime by using dug well water and sometimes by taking water from my neighbor who have purchased the tanker water. I haven’t purchased the tanker water for the household use but have purchased only for drinking purpose. It is very difficult to purchase water due to my financial status. I have seven family members and we need a jar of drinking water each day. That requires fifteen hundred rupees (Rs. 1500) per month for the drinking water which is quite difficult to manage. Therefore, I also sometimes buy well water for drinking and all the household purposes so as to minimize the expenses. The well water is cheaper than the Jar water and it helps me to reduce the expenses. I need to spend only Rs 3 per Jar.”

According to R8,’’ The Tole has done a great job to minimize the water scarcity problem. Many activities are carried out by the committee in the Tole such as digging wells taking the help from local people, the KUKL and NGO, making it drinkable by filtering and using other means of technique to purify and selling drinkable water to the local people. At that time, we dug two wells but currently only one well is in use, another is in the process of use. We have taught and given knowledge about the rainwater harvesting technique with the help of the NGO named “PASCHIM PAILA” to the community people. This seems somehow effective.

In the “GUTHI HOUSE”, the party house of that community, the Tole has installed rainwater harvesting well with the help of the NGO ENPHO &PASCHIM PAILA. The collected water is also stored in the same well and filtered and provided to the people. If the water is not enough even after using the rainwater, we (the community people) buy tanker water for household use and jar water for the drinking

purpose. The community people admit that the dug well made by the CTSC helped a lot to minimize the scarcity of water. It would have been very difficult to adapt with otherwise."

According to R7, "To minimize the problem of water scarcity, the CTSC dug two wells with the help of KUKL as well as the participation of locals. We are using boring water from Balkumari which is not drinkable. Hence we use it only for other household purposes. Water from one of the two wells dug by CTSC is no more supplying drinkable water these days. This is under repair.There maining well is supplying water and is insufficient for us.

The cost to dig the well (nearly twenty five thousand rupees) was born by the local people of Chyasal. But a filter costing Rs.1, 25,000 (one lakh twenty five thousand rupees) was provided by the KUKL. In addition, two reserve tanks of the capacity 5,000 and 10,000literswere also provided by the KUKL. The chairman of CTSC also revealed that they actually need Rs. 14, 00,000 (fourteen lakh rupees) to get water from deep boring. "We are trying to arrange this amount from some other sources so that we can adapt with the current situation of water scarcity. It is not possible to restore and bring the stone spout in its original stage because people have constructed concrete buildings near its sources. To improve the situation, we have done a survey for digging tube wells in the Chyasal Tole.Municipality is helping us for the survey process. All of us are in the hope that the government will bring water from the Melamchi River and the water scarcity problem will be solved very soon."

According to R3, "To minimize the water problem, I started the rainwater harvesting techniques. Was compelled to learn this technique due to the situation and condition, and it was not my wish. The harvested water was used for different purposes like: washing clothes, cleaning dishes, using in toilet, watering the flowers

etc. Because of the lack of the reserve tanks, we collect rainwater in the tank of 500 liters and other drums of 200 liters capacity so as to use in the scarcity period."

According to R4, "To reduce the water problem, I buy water from wells and tankers as and when needed. Being a tenant, do not have any access to rainwater harvested by the house owner.But I wish to pay if the house owners manage the rain water harvesting technique. This can probably reduce the problem of water scarcity."

R5 and R6 gave the similar responses. R5stated, "I do not need to use any alternative source of water because I have got enough water from KUKL and I never need to spend money for water for any purpose. But I see scarcity by observing to the other people in the surroundings and Upper Chyasal. I assume that the scarcity really occurs in Chyasal Tole. I think here is scarcity in Chyasal only due to the inefficient water distribution pattern from KUKL and the drying out of the stone spouts". She further added, "To adapt with this water scarcity problem, the Chyasal Tole Sudhar Committee has put a significant efforts. They took the help of local people and the municipality as well to dig two wells, one in Upper and another in the Lower Chyasal. The well in Upper Chyasal is in operation at present whereas the well in the Lower Chyasal is under maintenance. This dug well has reduced the scarcity to some extent. She was ignorant about the other alternatives to adjust with the problems.

Summary of the Analysis

R7 happens to be a local leader who is not only local resident who has to face the problem of water scarcity both for drinking and agricultural activities, but also interacts with government agencies such as KUKL.

The response of R8 is similar because he is also in a similar local leadership position. While the perception of water scarcity is virtually the same, there were nuances in their responses about the community's adaptations strategies. For instance,

R7 insisted that without the various adaptation strategies like boring well, the situation would have been more critical, whereas, R8 insisted that the responses were far from adequate.

My qualitative research allowed me to uncover these multiple and sometimes nuanced differences in perception and adaptive strategies. The perception of R7 and R8 were shared by the rest of the respondents but with little articulation because of their non-leadership standings.

FGD findings in Upper Chyasal and Lower Chyasal

I conducted two FGDs, one in Upper Chyasal and other in Lower Chyasal, after I found two different patterns of water scarcity perceptions and responses. For Upper Chyasal, I gathered six respondents in local public school on Friday at 1:30 pm to make sure everybody would come to a convenient place at a convenient time. I offered tea and biscuits to increase my rapports and encourage their detailed participation as well as to thank them for their effort. This was necessary because many expressed doubt about the usefulness of this exercise while some were curious about new opportunities to solve community water scarcity problem.

I started broaching water scarcity and response themes according to my check list (see annex),however I noticed that some FGD respondents like local home owners tried to dominate the meeting while the tenants were hesitate to give answer. But I made sure I got their view points by separately asking for their answers despite the smirks on the face of the local home owners.

FGD with the Upper Chyasal Residents

While conducting FGD among six participants, of whom three were tenants and three house owners, of Upper Chyasal, they shared many things such as

- Easy access and availability of water in the past before ten- fifteen years

- No conflicts among the local people for water previously.
- Water availability started to decline since last ten to twelve years.
- Only few households had no easy access to water and they could get it from their neighbors as there were many stone spouts in the locality. Therefore, they had taken this issue very lightly.
- Gradually the all people, tenants as well as house owners started to feel the problem in getting water. The drying of stone spouts in the locality coincided with the decline in water supply by the KUKL.

In the past, KUKL used to supply water daily but gradually it started to decline and nowadays the people in Chyasal are getting water once in 5 days. This is really making the situation very hard to manage. Similarly, the stone spouts also started to flow in less quantity which led the people to feel the scarcity in Chyasal. And one of the local participants also said that extra or excessive quantity of water used to flow through the drainage (KULO) in the past time. This excess water was used to irrigate the crops at the bank side of the Bagmati River and near the drainage (KULO). But, as the volume of water decreased in the stone spouts, the water flow in the KULO also started to be reduced.

There are many recent changes in past 5-10 years such as:

- They needed to manage extra money to buy water.
- Difficult to maintain the personal hygiene and cleaning the house was becoming more difficult.
- They had to spend more time by standing in a queue for one jar of water.
- Chances of quarreling with the neighbors were high for getting water.

It was only recently, that the people in Chyasal had to pay money for water. In addition, they had to devote more time to get water. Sometimes, they had to quarrel

with other people to get even ½ jar of water. They needed to separate about Rs. 1000-1500 per month for water. So it was becoming a great problem to the people living there. This situation created major effects on their daily livelihood and profession. More than 70 % of people living in Chyasal were engaged in the business of the alcohol for which they needed a huge amount of water. This scarcity increased their problem further. This led to a reduction in the profit of alcohol producing business; and some of the people already stopped their business.

One of the tenants said that they also used to get water easily without quarrelling with the locals and others in the past. But now, the local house owners discriminate against them and give limited water even after making the payments. Tenants did not get chance to fill water in the stone spouts until and unless the house owners got enough water. She expressed that it was really a demoralizing and dehumanizing feeling.

The locals in the Upper Chyasal were compelled to use various adaptive measures because the water scarcity situation was unbearable. The KUKL water supply was not regular and the amount of water was also limited, which is not sufficient for them. In the Upper Chyasal, the space is very congested and there are no suitable places for digging wells. Similarly, the settlement of that area was also very much dense which makes the rainwater harvesting techniques difficult. For these reasons, the people were compelled to purchase water from the tankers for household use as well as for business purposes. For a family with four members they used to buy 2000 to 3000 liters of water per month which cost fifteen hundred rupees (Rs. 1500). They were buying jar water for the drinking purpose. Basically for the tenants, there were four members in a family. They needed at least fifteen jars of water per month which cost about Rs. 750.

All of the participants (including tenants and local house owners) replied that they were buying well-water dug by the CTSC. Well-water had helped them a lot in reducing water scarcity and to manage the water demand of people. The payment system also discriminated against the tenants because they had to pay Rs. 5 for twenty liters whereas local house owners used to pay only Rs. 3 for the same amount.

FGD with the Lower Chyasal Residents

FGD in Lower Chyasal was also conducted with six participants, three tenants and three house owners. In the Lower Chyasal people said that there was less scarcity of water than in the Upper Chyasal. The newly connected pipeline was also one of the reasons for having water regularly. Lower Chyasal being the new settlement, people constructed houses in a new way to adapt with the water scarcity that is they left some spaces for digging wells. They were getting water from KUKL once in five days which was not abundant but adequate for their daily need. Some of the houses in Lower Chyasal were facing scarcity of water which was due to the inefficient and improper pipeline system. They said that in the month of May, for the period of one month, they had less availability of water. During the remaining months, they had adequate water for all purposes. The scarcity in the month of May was due mainly to the diversion of water for irrigation of paddy fields in Pharping. Therefore, they used to buy water for drinking and used the stored water for other household purposes.

One of the participants elaborated the situation of water supply and coping strategies as follows. People from Lower Chyasal were getting water from KUKL once in five days. Water supply was only for two to three hours. They used to pump water from the pipe line so that they could get enough water to use and store. They had sufficient water for all purposes. They used to give drinking water to other needy people of Upper Chyasal and Lower Chyasal. There was less availability of water

only for one month so that they did not think about the alternative source of water. Except for the month of May, they never needed to spend money to buy water. She said that the major reasons for water scarcity in Chyasal was mainly due to the inefficient water distribution pattern by KUKL and the drying out of the stone spouts in the locality.

In the past, about 30-40 years ago, stone spouts were the main water sources for the local people. All people depended on these stone spouts for all purposes and no water scarcity was felt at that time. All the water demand or the requirement of that locality was fulfilled by the stone spouts. The stone spouts were enough to fulfill the water demand at that time. Similarly, the water supply from KUKL was also regular at that time. People from other localities also used to come to the place to collect water. Till 2058B.S. the people of Chyasal never experienced the scarcity of water. Gradually the water scarcity problem started to increase.

To adapt with the water scarcity in Chyasal, the Chyasal Tole Sudhar Committee had been doing some important tasks, example, dug two wells (one in Upper and one in the Lower Chyasal).The well in the Upper Chyasal was in use and was helping a lot in reducing the water related problems. The international organization called UNHABITAT was working in this area related to water issues. It was also helping local people by teaching the techniques of rainwater harvesting. In addition, the financial support was also provided by UNHABITAT. Another organization called ENPHO was providing some technical supports for rainwater harvesting. This technique was somehow helping the local people to adapt with the scarcity. Some of the people who had reserve tanks at their homes started to collect the rain water, and were benefitting by using the collected water during water scarce period and in the dry season.

My Observation

Chyasal is the historical place where water used to flow abundantly from stone spouts and wells had sufficient water year around. It can be said that now there exists a scarcity of water for drinking as well as for the household purposes.

I am the resident of that area and I had experiences from last seven, eight years like, I remember before seven, eight years that the volume of water flowing through the stone spout started to decrease to a trickle during the dry period of the year around April .However, for the last five years I observed that the stone spout dried completely during October till April.

The quality and quantity of the water supplied by the government authority of KUKL has sharply declined over the last seven /eight years .About seven /eight years ago, we used to get tap water for all days of the week and with no incidence of dirty and sewage mixed water from porous water pipes. From the last five/ six years, KUKL water supply started to supply water alternatively and from the last three years, the water supply has declined to six times a month , that is once in five days and which is also not reliable. At the time the dirty and sewage mixed water is supplied in every instance of water supplied dates in spurts alternatively mixed with clean water, so users have to be on full alert during water supply hours.

In the Upper Chyasal the availability of water is inadequate in the summer season and short supply in the winter season, whereas in the Lower Chyasal the availability of water in the summer season is adequate and in the winter season it becomes somewhat inadequate.

The situation of the stone spout is somehow tolerable. The situation of individual tap in the Upper Chyasal is all right. All the people were hoping to have the access of drinking water. Similarly the individual tap of Lower Chyasal is good in

comparison with the Upper Chyasal. In Upper Chyasal people started to reduce and reuse the water since 2060B.S. according to the respondents. Similarly, the people of Lower Chyasal to some extent have also developed the habit of reducing the use of water. The Upper Chyasal people were purchasing the water daily in the dry season for everything, whereas, the Lower Chyasal people were purchasing the water very rarely. They used to purchase only once in the month of March and also only for the drinking purpose, they used the stored water for other purposes .The people living in Upper Chyasal used to buy well water as well for the household use. Usually the people of Upper Chyasal faced long queues to get water whereas the Lower Chyasal people only occasionally stood in a queue to get water. In the Upper Chyasal the water outflow pattern of KUKL is irregular.

People pay whole day for getting water but they failed to get water because only in the few houses did water flow from the taps, while the rest of the houses had no flowing water. People of Upper Chyasal became very frustrated due to not getting the water whereas in the Lower Chyasal the people were getting water from KUKL twice a week regularly. Thus, this was adequate for their daily use.

In Chyasal Tole there is one measure adopted to minimize the water scarcity in that locality but that technique had helped other people as well to minimize their water problem. By taking the help from locals and the other initiatives like help from Lalitpur municipality, people have constructed the dug well; the rain water is also collected in that well in the rainy season. The water is distributed to the people once in the two days, locals as well as other people come over there to take water and the rate of water per jar is different to locals and the rented people. People have to stand in a queue for hours to get water in the dry season. The people of that community rarely have the rainwater harvesting mechanisms. Only the well-known or the

reputed people of that community have installed the rainwater harvesting technique. People of Upper Chyasal also purchase the water from the tanker for their household use. People show the anger to each other when they need to stay in a queue, the people of Upper Chyasal, due to the shortage of water in the well sometimes quarrel with each other when they could not get water whereas the people of Lower Chyasal never needed to face conflict.

Perception of NGO Representative

In an interview with the Resource Centre Representative of ENPHO, she revealed that they have been involved in Chyasal since 2010. In order to select Chyasal as their working place regarding water issue, firstly they had carried out community based survey whether or not the area is facing the problem of water and did the informal conversation with different local people of Chyasal such as with chief of CTSC etc. Then only they finalized and started to work.

The organization had run different training programs regarding proper use of water; they provided different ideas, knowledge and techniques of rainwater harvesting to minimize the water problem. The local people have also been taught the way of water filterization and different ways of community based activities to save the environment and to build the good co-ordination among the people. The organization had made the youth circle to which they gave training and made them capable to run the training in their own community so that later on they could carry out regular follow up and regular monitor, whether or not their work was successful.

To carry out such a project ENPHO received financial support from UN-HABITAT. This organization had helped to pay the cost of all materials used to install the rainwater harvesting mechanism, pay for the cost of different seminars, trainings etc. While working in Chyasal, the ENPHO candidates had faced some of

the obstacles as well, As it was one of the historical places, which was dominant by the Newari people, specially 'Byanjankar'.Most of the old generation people even do not understand and couldn't speak Nepali language. So the NGO people had faced a language problem, similarly at first local people did not reply and respond in a good way by which the ENPHO candidate faced difficulty to dig out the findings what they intended.

At present there are no future plans to further minimize the water scarcity. They have been doing the follow up of the past activities and also have developed one Resource Centre Committee or library in the community school in Chyasal, where the local people have access to information to increase their awareness and enhance knowledge. And they could come over there and collect information to enrich their knowledge.

Future Planning

AccordingtoR7, he chairman of CTSC, "To improve the situation, we have done a survey for digging tube wells in Chyasal Tole. Municipality is helping us for the survey process. The local people are of the opinion that the government will bring water from the Melamchi and the water scarcity problem will be solved very soon."

According to R8, the advisor of the CTSC, "We are planning to dig more wells to adapt with the water scarcity. Similarly, we are also planning for the deep boring. For these activities, we have done a survey on possibility of the boring water in Chyasal by taking the help from the municipality. The municipality has helped the Tole by providing Seventy Five Thousand Rupees (Rs. 75,000) for the survey. And the committee has done a survey to check whether this place is suitable for deep boring or not. And fortunately we got a positive result, so we have been planning to

do the deep boring in near future to adapt with the problems of water in our community.”

CHAPTER V

DISCUSSION, IMPLICATIONS, AND CONCLUSION

Chapter Overview

This chapter deals with the summary of the findings, the discussion including its adaptive measures. I have also presented the implication based on findings and conclusion. Finally, I highlight my learning and reflection on the entire process of this study.

Summary of the Study

This study was primarily designed to study the water scarcity and its adaptive measures in one of the Toles of Lalitpur metropolitan city. This study has considered a number of individuals including house wives, local leaders, and NGO representative. Information both from the primary as well as secondary sources were used for the successful completion of this study. A review of necessary literature from theoretical perspectives served the purpose of collecting necessary information from secondary sources.

This study was made using purposive sampling while sampling stakeholders from the total population. In the data collection process, I have collected all the data personally. A self-designed and pre–tested, valid and reliable themes in English was used for data collection

Summary of the Findings

From the analysis and interpretation of the data I collected through interviews, focus group discussion and observations; I have obtained the following findings:

- The local people of Chyasal have felt decrease in water availability or the scarcity since 2060 B.S. They thought that it was because of the unsystematic and untimely rainfall patterns. Similarly, they assumed that water scarcity arose due to the dense population living in the small area. They also realized that the construction of the new buildings with personal wells and concrete compounds helped to decline the water levels. The experience of Chyasal community in terms of water scarcity due to dense population and local sub-communities capturing the groundwater flow resulting in the buildup of conflict has been stressed by Fuller and Harhay, 2010 in south western United States.
- Availability of water resource in developing countries is depleted due to increased population (Khatri&Vairavamoorth, 2007), which my research validate too.
- It was found that the local people were facing lack of sufficient water for all purposes although they were adjusting with the little amount of the water available from KUKL. During the absolute scarcity (that is December to May); they had to buy water for all uses. Most of the people had faced scarcity of water mainly for the six to seven month, from December to May.
- The availability of water was abundant in the past, before 20-60 years, and reduced somewhat from last 10-15 yrs. It reached to its maximum from last 6-8 yrs. The stone spouts were fulfilling all water demands of that locality. Therefore, there was no problem regarding water until water from the spouts was enough for people. This finding is confirmed by Poudel (2007) who found traditional stone spouts supplied the largest proportion of the non-governmental water supply.
- The KUKL, one of the main water suppliers of water in Kathmandu Valley, could not fulfill the demand. At the same time, KUKL water supply pattern was not

regular and unreliable. So the people couldn't depend on KUKL for the water supply.

- People living in Lower Chyasal (except some of the houses) were getting water from KUKL once a week regularly. Although there was disruption in the water supply by KUKL for the time being, it was solved later on. People in Lower Chyasal feel themselves fortunate to get more water supplies compared to the Upper Chyasal.
- Theater scarcity forced some of the people to change their profession of producing alcohol. They needed a large amount of water for alcohol production which became difficult in the water scarce situation. Thus they stopped their business also. In addition, some of the people changed their habit of taking bath daily.
- The local people had different experiences regarding water availability although they stay in the same locality for long. All of the people living in Upper Chyasal were the victim of water scarcity; they were facing many problems of water to run their daily lives. On the other hand, except some of the houses, the people at Lower Chyasal were managing or they are adjusting water easily.
- People were forced to buy water at least once in the year that is in the month of May. During remaining months the water available from KUKL was enough for them. Thus, it could be concluded that, even in the same area, the water distribution pattern was different. The Upper Chyasal was more suffered by this problem of water scarcity compared to the people staying in Lower Chyasal.
- People thought that the main reason behind the regular supply of water in the Lower Chyasal was because of the sloppy area. On the other hand, Upper Chyasal was situated at more height and got less water supply.

- To manage this problem, most of the people in Chyasal started to harvest rainwater. In the past they used to harvest the rainwater in the drums of 200 to 500 liters, but recently they were involved in the “MAHILA SAMHUHA” and were trained to harvest water in a systematic way. For this, the local people were given the training of rainwater harvesting techniques from the officials of municipality.
- Similarly, with the financial support from UNHABITAT and the technical support from NGO called ENPHO, NGO called PASCHHIM PAILA worked in Chyasal Tole to minimize the water scarcity. They also trained the people to harvest the rainwater.
- The “GUTHI HOUSE”, the party house of Chyasal said with the help of the NGO PASHIM PAILA, installed the rainwater harvesting mechanism to harvest the rainwater. In addition collection and filtration facilities were also provided to the people.
- To minimize the water scarcity, the CTSC dug two wells with the financial help from Lalitpur municipality as well as contribution from the locals. Those wells were playing a vital role in minimizing the scarcity of water to some extent. Otherwise people would have been to face the acute water problem. People could get their turn to collect water in every alternate day by paying tariff. However, the tariffs were different for tenants (Rs 5 per jar) and local house owners (Rs.3 per jar).
- People in Chyasal also used to buy water from the market weekly, fortnightly and monthly depending on their water demand. During the rainy season, they used to buy water for the drinking purpose only; and in the dry season they used to buy water for drinking as well as for other household purposes.

In an average, for the family with six members, they needed to separate rupees fifteen hundred (Rs. 1500) for drinking water and rupees one thousand (Rs. 1000) for the other household purposes.

- According to the chairman and the other members of the CTSC, they had been planning to get the deep boring water to minimize the water problem from their locality. They already performed the survey for deep boring water in the locality. The Lalitpur municipality provided financial support of seventy five thousand rupees (Rs. 75000) to carry out the survey and the result indicated the high probability of getting water from the deep boring. According to the CTSC, fourteen lakh rupees (1400000) would require to complete the work of boring water. Although they were unable to manage this amount, they were keeping their campaign to raise the fund to materialize this work.

Discussion on Findings

On the basis of comparison between the present study and a number of previous studies and literature, this section proposes a discussion of the study. The present researcher has limited this work by comparing and contrasting the findings of the present study with different experts, researches and literature mentioned in the literature review.

According to this research, people felt decrease in water availability or the scarcity. They think that, it is because of the unsystematic water supply, pollution of the water sources and untimely rainfall pattern. Similarly, they perceived that water scarcity arose due to the dense population living in the small area which was similar to the findings of Paschim Paaila (2011) and (Manez et al., 2012). However, such empirical “facts” of water scarcity perception due to population density shows tremendous heterogeneity in terms of social parameters such as geographical location,

gender, literacy and even the attitudes they displayed during interaction underscores the efficacy of the choice of constructivism and qualitative research to explore this problem. Paschim Paaila (2011) states that the availability of water was not sufficientin Chyasal Tole and (Manez et al., 2012) an important driver behind water scarcity is population growth and additionally, the predicted impacts of climate change will further accelerate the problem.

By the financial support from UNHABITAT and the technical support from NGO called ENPHO under which the team working as PASCHHIM PAILA worked in Chyasal Tole to minimize the water scarcity and they had also trained the people to harvest the rainwater. However, they could not manage to solve the problem fully and the water scarcity problem still exists in the Chyasal Tole (Paschim Paaila, 2012).

According to the Water for Asian Cities Programme Nepal, United Nations Human Settlements Programme, water movement in Patan with reference to traditional stone spouts in Nepal revealed that the source of Chyasal Hiti was believed to be in Kari Keba area, some 200m west of the Hiti. The Kiri Keba aquifer region, east to Khumbheshwor Temple, is occupied by new houses in last two decades. This Hiti was serving as water source for surrounding neighborhoods like ChikanBahil , Ombahal, Kwyelachhi, Bhindyolachhi, Khapinchhen, Bholakhel, Sankhamool, Bhelachhen andChochhen encompassing around 1200 houses. Similarly, the findings of the present research also indicated that the availability of water was abundant in the past (until 20 yrs. before). The water source has started to reduce for the last 10-15 yrs. The problem has become critical for the last 6-8 yrs.

The stone spouts (Hiti) were fulfilling the all water demand of that locality. There was no problem regarding water in spite of not having piped water from KUKL. They used to get sufficient water to fulfill their needs. Construction of new

buildings, roads, personal wells and concrete compounds of houses helped to decrease the availability of ground water. Similar result was found by Thanju (2012) who studied water problems in Kathmandu Valley. He stated that due to rapid urbanization, the large land surfaces are sealed by concrete and road pavements so that water does not percolate to the ground water aquifer.

It was revealed that the community people were looking forward for the water from the Melamchi Water Supply as was also mentioned in the article published in the Kathmandu Post (2012). According to the article, the MWSDB (Melamchi Water Supply Development Board) planned to complete the project by 2016.In addition; the MWADB has a plan to supply water in Kathmandu by September 2015.

Our finding indicated that the KUK Lcould not fulfill the water demand of the Kathmandu Valley. Similar results obtained by Thanju (2012) stated, “Despite having about1500mm.of annual rainfall (equivalent to 15 million liters per hectare), there is an acute drinking water shortage. Against the demand of 350 MLD, the supply is only 135 million liters per day in the wet season and 90 MLD in the dry season in Kathmandu valley”.

Until recent years, people of Chyasal used to buy water only in the month of May for drinking; and in the remaining months water available from KUKL was enough for them. The water availability in the Lower Chyasal was not critical in comparison to the Upper Chyasal. Thus, our research showed that, even in the same area, the water distribution pattern was different in Upper Chyasal and Lower Chyasal. Although KUKL states that ground water contribution in KUKL supply was 35% in the wet season and 65% in dry season in all the areas (Thanju, 2012), Upper Chyasal used to get less amount of water supply from KUKL system.

Implications of the Findings

- The problem of water is more acute in Upper Chyasal.
- In Upper Chyasal there is extreme population density and house density which increases the total quantity of water demanded and limits responsive capacity like: tube wells.
- In Lower Chyasal population density is less and house density is also less so the social capital of organizing tube well and water distribution depots are possible.
- In order to design effective water scarcity response pattern in dense habitats or in adapting to acute water scarcity problem in urban areas of developing countries, the experience in Chyasal is instructive.
- The Chyasal experience shows that when population density is so high that there is no place to bore wells or locate community water tanks social capital about organizing community based institution is unavailable.
- Adaptation by local institution alone is often not adequate for the degree of water scarcity problems.
- Adaptation strategies should be driven by community interest and initiatives to mobilize resources from municipal, national and NGO institutions.
- Chyasal problem is similar to siliguri in terms of fast growing population and urbanization without planning strategies and urban amenities like drinking water supply.

Conclusion of the Study

From the findings, I conclude that in Chyasal Tole the scarcity of water exists and it is hampering the lives of people in different ways. There was abundant `amount of water in the past. It was sufficient for all purposes. The single stone spout used to

fulfill all the water need of the people. There happens the drastic change in water availability within these ten to fifteen years. Even in the same place the level of scarcity is different. The Upper residents are facing more problems than that of Lower one.

The availability of water depends upon the season. In the rainy season due to the stone spout there is abundant water. The people of the Upper Chyasal are not getting the water regularly even in the rainy season whereas in the Lower Chyasal only except some of the houses, mostly the people are getting water once a week for one to two hours regularly throughout the year. Because of the scarcity, people need to stand in the queue and need to spend time; they are also spending money to adjust with the water problem. It can be concluded that, the people are compelled to separate the money to fulfill their water needs either they could afford or not. It is found that ,those who can afford they are not standing in a queue and getting Jar water and those who cannot afford they use to pay time and similarly the less amount of money compared to the Jar water. The local people are getting enough well water once in two or three days by paying Rs3 per Jar and the rented people were getting only the limited amount of water although they pay more than5 per Jar, which is Rs 2 higher than the locals.

With the help of "MAHILA SAMUHA", the support from the Lalitpur municipality and the NGO "PASCHIM PAILA" has done the tremendous work, which is they taught rainwater harvesting technique to the people of the Chyasal Tole which really helped the people to manage the water problem to some extent. To adapt with the water problem the CTSC has done the wonderful work of digging wells, among the two wells, one is in the use and another is under the process of use.

In the “GUTHI HOUSE” the party house of that community, with the help of the NGO, PASHIM PAILA there is an installed mechanism to harvest the rainwater and the harvested water in the rainy season is stored in the same well and they make the water drinkable by filtering and provide to the people.

The KUKL has provided the tanks having the capacity of 10000 liters and 5000 liters, in which they store and filter the water. It can be concluded that the Casco’s providing the filtered and drinkable water to the people. From the findings, it can be concluded that the dug well has been reducing the water scarcity in Chyasal. People living in that place are purchasing the well water to fulfill their water needs. If it is not enough, they are personally purchasing the tanker water for household uses. Although they do not want to drink that water, due to the scarcity and not having the other alternative sources they were compelled to drink the well water.

The local people were very much unsatisfied with the inefficient water distribution system of KUKL and through my observation it can be concluded that in the Upper Chyasal, most of the people have a generator in their house so that they can get water even at the time of load-shedding.

From the findings, I conclude that the CTSC has been planning for future to eliminate the water problem from Chyasal forever. For that they have completed the survey for deep boring in Chyasal with the help of Lalitpur municipality which showed the positive answer, the committee has been trying to have such a big amount of money and start the process of deep boring. Thus, we can expect that in the coming future, we will be getting the boring water easily and there will be no scarcity of water in Chyasal.

REFERENCES

Armitage, A. (2007). *Mutual research designs: Redefining mixed methods research design.* Retrieved from www.ethiopia-ed.net/images/1602209283

Adhikari, S. (2011). Water reality.*The Himalayan Times Daily*, p. 3.

Bhatpara, B., Jacana, D., Dhamala, K., Mudvari, M., Dingo, M., Shrestha, P., Gyawali, S. (2005). *Local area plan of ward no. 9: Lalitpur sub-metropolitan city.* An Unpublished Report. Tribhuvan University Institute of Engineering.

Bajracharaya, S. (2009). *Discrimination against girls in school and at home: Their perceptions & responses* (Unpublished M Phil thesis). School of Education, Kathmandu University, Nepal.

Best, J. W., & Kahn, J. V. (1998). *Research in education*. New Delhi: Prentice-Hall.

Best, J. W., & Kahn, J. V. (2007). *Research in education* (9th ed.). New Delhi: Prentice-Hall.

Best, J. W., & Kahn, J. V. (2011).*Research in education* (10th ed.). New Delhi: Pearson Prentice-Hall.

Bryman, A. (2009). *Social research methods* (3rd ed.). United States: Oxford University Press. United States

CBS. (2011). Government of Nepal National Planning Commission Secretariat Central Bureau of Statistics Kathmandu, Nepal, Volume 01, NPHC 2011

Cohen L., Manion, M., & Morisson, K. (2001). *Research methods in education*: (5^{th}ed.). London: Routledge

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed methods*. California: Sage Publications

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2003). *The Landscape of qualitative research: Theories and issues.* New York: Teachers College Press.

Denzin, N. K., & Lincoln, Y. S. (2005). Introduction: The disciplines and practices of qualitative research. In *Handbook of qualitative research* Thousand Oaks: Sage Publication.

FAO. (2012). *Coping with water scarcity: An action framework for agriculture and food security.* Rome, Italy: Food and Agriculture Organization of the United Nations.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*, 8(4), 597-607. Retrieved from http://www.nova.edu/sss/QR/QR-4/golafshani.pdf.

GoN. (2009). *National urban water supply and sanitation sector policy* (4th Draft). Kathmandu: Government of Nepal, Ministry of Physical Planning and Works.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Danzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp.105-117). Thousand Oaks, CA: Sage.

HMG/Nepal. (2002).*Water resources strategy Nepal: Executive summary*. Kathmandu: His Majesty's Government of Nepal, Water and Energy Commission Secretariat.

ICIMOD/MoEST/UNEP. (2007). *Kathmandu valley environment outlook.* Kathmandu: Author.

IFS. (2003). *Strengthening capacity for water resources research in developing countries.* Draft Report, International Foundation for Science.

Khatri, K. B., & Vairavamoorthy, K. (2007). *Challenges for urban water supply and sanitation in the developing countries.* Discussion Draft Paper. UNESCO-IHE, Neatherlands.

Manez, K. S., Husain, S., Ferse, S. C. A., & Costa, M. M. (2012). Water scarcity in the supermodel archipelago, Sulawesi, Indonesia: Past present and future. *Environmental Science & Policy , 23*, 74-84.

McNiff, J. (1992). *Creating a good social order through action research*. Dorset: Hyde Publications.

Myers, M. D. (2009). *Qualitative research in business & management*. London: Sage Publications.

Nepal, P. (2011). Dump in the river. *The Himalayan Times Daily*, p. 8.

Nepal, W. A. (2010). *Nepal: Country strategy 2010-2015.* Water Aid Nepal.

Nepal, W. A. (2008). *Water Aid Nepal 's experiances in community-based water resource management.* Kathmandu: Water Aid Nepal.

NHRC. (2009). *Situation analysis of environmental health in Nepal 2009*. Kathmandu: Nepal Health Research Council.

Opielka, M. (1996). *Social ecological work and planning - Remarks on a social-ecological theory of Action (SET)***.** Bonn: Institute for Social Ecology.

Paschim Paaila. (2011). *Household survey report: WASH led youth empowerment project*. A Report Submitted to the UN-HABITAT, Kathmandu, Nepal.

Patton, M. Q. (1999). *Qualitative evaluation and research methods*: London. Sage Publications.

Patton, M. Q. (2002). *Qualitative evaluation & research methods* (3rd ed.). Thousand Oaks, California: Sage Publications.

Ritchie, J., & Lewis, J., (Eds.). (2003). *Qualitative research practice: A guide for social science students and researchers.* London: Sage Publications.

Shakya, A. (2009). *Understanding the motives for responsible environmental behavior & its educational implication: A qualitative study* (Unpublished PhD dissertation). School of Education, Kathmandu University, Nepal.

Sharma, A. (n.d.). *Water harvesting context in the Indian subcontinent.* Roorkee, India: National Institute of Hydrology.

Taylor, S. J., & Bogdan, R. (1998). *Introduction to qualitative research methods* (3rd ed.). New York: John Wiley.

Thanju, J. P. (2012). Rainwater harvesting for recharging groundwater and local water management in Kathmandu valley. *Hydro Nepal, 11,* 61-63.

WAN. (2005). *Water laws in Nepal: Laws relating to drinking water, sanitation, irrigation, hydropower and water pollution*. Kathmandu: Water Aid Nepal.

WAN. (n.d.). *Nepal country strategy 2010-2015*. Water Aid Nepal, Lalitpur, Nepal.

Whitely, J. M. (1999). *Conceptual social ecology*. California: University of California, Irvine.

UN-HABITAT. (2008). *Water movements in Patan with reference to traditional stone spouts*. Kathmandu: UN-HABITAT Water for Asian Cities Programme Nepal.

UN-Water. (2006). *Water, a shared responsibility*. The United Nations World Water Development Report -2. Paris and London: UESCO and Berghahn Books.

UN-Water. (2007). *Coping with water scarcity: Challenge of the twenty-first century*.

Whitely, J. M. (1999). *Conceptual socio ecology.* Retrieved on June 2010 from htpp://socialecology.uci.edu/cse/cse.html

Yin, R. K. (2003). *Case study research: Design and method*. California: Sage Publications.

Zainal, Z. (2007). Case study as a research method. *Jurnal kemansiaan bil, 9.*

APPENDICES

Appendix A

Checklist of Themes

Theme	Questions	Respondents	Tools used
Peoples' perceptions towards water scarcity Past trends & Present scenario regarding water availability	1. Is water availability plentiful throughout the whole year or depends upon seasons? 2. Do you feel any difficulty to get water? 3. Would you tell me how you felt water scarcity? 4. In your view, what are the main causes of water scarcity? 5. What is the water supply pattern of KUKL nowadays? 6. How many hours per day & how many days per week do you get water? 7. Is the water enough for your drinking & household purposes? 8. What was the water supply pattern of KUKL in past (before 20 yrs.)? 9. Have you done any queries to KUKL for their water supply pattern? 10. What kind of queries have you done? 11. Does the KUKL pay attention in solving your queries?	Housewives	In depth Interview, FGD, Observations

	1. Do you observe/notice any problem in this locality? 2. Is here any water problem regarding drinking and other household purpose? 3. What is the water supply pattern of KUKL nowadays? 4. What was the condition in the past? 5. Would you tell me how you noticed scarcity of water? 6. What might be the leading reasons of water scarcity?	Chief and Advisor of CTSC	In-depth Interview

Measures adapted by people	1. How do you treat drinking water? 2. Do you have your personal well or well-constructed in the community? 3. Is water from your source drinkable? 4. Have you applied any alternative to solve your daily water need? 5. Do you buy water from private tanker? 6. Would you tell me how much money do you need to spend per month to buy water from private tanker? 7. Can you tell me here any organization working regarding minimizing the water scarcity? 8. Do you get any help or contribution From CTSC in response to it? 9. How are those organizations serving in minimizing your water problems? 10. Are you satisfied or not from their work?	Housewives	In-depth interview, FGD and observation
	1. What is the name of the NGO where you are involving? 2. Since when are you involving in this place (Chyasal Tole)? 3. Why did you choose Chyasal Tole as your working place? 4. In your view what is the present situation regarding water availability in this Tole? 5. Since your involvement what are the activities you have carried out to minimize the water scarcity? 6. Is it effective to reduce/eliminate the problem?	NGO representative	In-depth Interview

	7. How much budget have you invested here to solve water problem? 8. From where have you got such help? 9. What are the obstacles and burden you have faced while working here in Chyasal Tole? 10. Do you have any future plans in this place regarding this water problem? If yes what are they?		

Appendix B

Observation Checklist

1. Availability of water
2. Situation of stone spout/private taps
3. Water use(reduce, reuse and recycle)
4. Purchasing from tanker
5. Purchasing from well
6. Stay in a queue for water
7. Frequency of water supply from KUKL
8. Any mechanism adopted or followed in response to water scarcity as rain water harvesting.
9. Attitude and emotion as anger, quarrel etc.

Appendix C

List of tools and Respondents used in Research

Theme	Tools	Number of respondents	Respondents
Peoples' perceptions towards water scarcity, past trends and present scenario of water availability in Chyasal.	Interview, FGD & Observation	8+12=20	Chief of CTSC Advisor of CTSC Women of old and young generation Two local women and two tenant women Six participants from Upper and six from Lower Chyasal among them three/three from local women and three/three from tenant respectively.
Measures adopted by people in Chyasal to minimize the water scarcity.	Interview, FGD & Observation	8+1+12=21	Chief of CTSC Advisor of CTSC Women of old and young generation Two local women and two tenant women Six participants from Upper and six from Lower Chyasal among them three/three from local women and three/three from tenant respectively. Research Centre Assistant of ENPHO

Appendix D

Key Respondents

S.N.	Age		Literacy	Address	Occupation
R1	68	Old Generation Woman	Literate	Chyasal-9,Lalitpur	Housewife
R2	23	New Generation Woman	Literate	Chyasal-9,Lalitpur	Student
R3	45	Woman, Local	Illiterate	Chyasal-9,Lalitpur	Sales woman
R4	52	Woman, Tenant	Literate	Hetauda	Business of running canteen
R5	33	Woman, Tenant	Literate	Dolakha	Handicraft
R6	46	Woman, Local	Illiterate	Chyasal-9,Lalitpur	Housewife+ Farmer
R7	46	President of CTSC	Literate	Chyasal-9,Lalitpur	Businessman
R8	61	Advisor of CTSC	Literate	Chyasal-9,Lalitpur	Principal

Appendix E

NGO Representative

S.N.	Organization	Designation	Address
1.	ENPHO	Resource Centre Assistant	Baneshwor,Kathmandu

Appendix F

Participants of FGD

FGD in Lower Chyasal

S.N.	Address	Age	Education	Occupation
1.	Chyasal-9,Lalitpur	49yrs	SLC	Service in Finance
2.	Chyasal-9,Lalitpur	34yrs	B.Ed.	Teacher
3.	Chyasal-9,Lalitpur	29yrs	BBS	Housewife
4.	Dharan	35yrs	SLC	Housewife
5.	Banepa	32yrs	SLC	Housewife
6.	Ramechaap	38yrs	Literate	Thanka painting

FGD in Upper Chyasal

S.N.	Address	Age	Education	Occupation
1.	Chyasal-9,Lalitpur	28yrs	MBS	Student
2.	Chyasal-9,Lalitpur	40yrs	Literate	Farmer
3.	Chyasal-9,Lalitpur	31yrs	SLC	Business of Hotel
4.	Ramechaap	36yrs	Illiterate	Handicraft
5.	Kabre	50yrs	Literate	Peon
6.	Biratnagar	32yrs	Illiterate	Housewife

Appendix G

Some Captions During the Study