

**“An Assessment of Sustainable Elements of Traditional Water Sources  
Management in Lalitpur District”**

**A case study on Stone Spouts of Patan area of Lalitpur District**

**A Thesis submitted to**

**Faculty of Humanities and Social Sciences  
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Master’s of Arts in Rural Development**

**by**

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LETTER OF RECOMMENDATION

This Thesis entitled "Assessment of Sustainable Elements of Traditional Water Sources Management in Lalitpur District: A case study on Stone Spouts of Patan area of Lalitpur District" has been prepared by Mr. Suraj Kumar Sharma under my supervision as a partial fulfillment of the requirement for the degree of Master of Arts in Rural Development.

To the best of my knowledge the study is original and carries useful information. I recommend it for evaluation to the report evaluation committee.

(Supervisor)

2066/09/12



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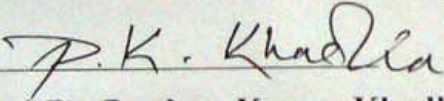
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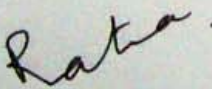
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### APPROVAL SHEET

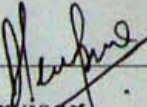
This is to certify that the Thesis submitted by Suraj Kumar Sharma entitled “An Assessment of Sustainable Elements of Traditional Water Sources Management in Lalitpur District” A Case Study on Stone Spouts of Patan area of Lalitpur District has been approved by this department in the prescribed format of the faculty of Humanities and Social Sciences.

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## Abstract

Safe, adequate and sustainable water supply for all is one of the main social goals enunciated at global level in the past few years. One quarter of the developing world's population still lacks clean water while millions die annually from water related diseases. As the world population continues to grow, need and demand for water escalates. The shortage of water is already with Kathmandu dwellers and it is certain that the harder time lies ahead. In order to resolve the scarce water situation, management of traditional water sources such as stone spouts, wells, ponds, and water holes should be seriously looked at and sustainable solutions to conserve the facilities should be found out. Sustainable solutions, here, defines, relatively long life span of water facilities which should meet the requirement of users and should be environmental friendly, maintained and operated easily and at low cost, should be adaptive to changing environment and efficient. There are more than 420 stone spouts and over 200 traditional wells in Kathmandu Valley, which are still in use. But these are in a very sorry condition due to lack of conservation and management. Even small attempts to conserve these facilities could be a great relief to the residents of the valley. These could be managed and conserved only through community-based approach as they are so much attached with the livelihood of people culturally, traditionally and religiously.

The study has been conducted to assess the sustainable elements of traditional water sources and their management practices at the local level. It was conducted within the Kathmandu Valley, especially Patan area of Lalitpur District through purposive sampling. Residents living near and surrounding the traditional water facilities, specifically the Newar female groups and elderly groups were interviewed. The outcomes of study anticipated to provide general picture of traditional water facilities, sustainable elements for their efficient management and adaptability of the system.

The findings showed that among 56 stone spouts in LSMC, only 44 i.e. 79% are in functioning state and remaining have either stopped flowing, submerged under water or extinct. It was noticed that spouts located in the settlement areas are functioning. Among 18 sample taken for the study, 61% of spouts have good water discharge; 89% of them have drainage in normal condition; most of the spouts; 44% were seen established during Malla period; 56% of them have a kind of management body to look after its management and, 67% of the spouts' water is being used for drinking, bathing and washing clothes. Among the tested water sample from 20 stone spouts, 11 i.e. 55% have nitrate concentration above WHO drinking water guideline value, one have excess iron, all the water samples had ammonia beyond the guideline value, chloride content within the value and all showed positive result in microbiological tests. Since, the count of microbiological test was limited to positive and negative test; severity of contamination cannot be concluded.

Management practices being performed by management committee of some spouts' such as Alko Hiti, Iku Hiti and Thapa Hiti shall be considered as the example of how these water spouts could be conserved and benefit the people. It was noticed that management of spouts was being easier in a homogeneous community rather than a heterogeneous community. It was also found that the culture of celebrating traditional festivals like 'Sithi Nakha', 'Yana Punchi', 'Indra Jatra' and performing morning rituals in the spouts still exists. These traditional activities are not only important religiously but also have been helping to keep traditional water spouts working, clean and sustainable.

Stone spouts are a unique feature of not only cultural heritage but also the centuries old water supply system, which could fulfill water demand of almost 30% of the total population of LSMC. These spouts have traditionally been at the center of community life but sadly; many of these spouts have fallen into disrepair. Thus, the study has recommended the management to build pollution control mechanism, separate drainage for storm water and sewer, imply the metropolis with ground water recharge technologies and encourage community to conserve traditional water facilities. Further study on different perspective of stone spouts such as its hydro-geological flow and detail chemical parameters is suggested.

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## Acronyms

A.D.	after the death of Christ
a.m.	Anti Meridian
B.S.	Bikram Sambat
CBS	Centre Bureau of Statistics
CE	Christian era
DWSS	Department of Water Supply and Sewerage
e.g.	for example
ENPHO	Environment and Public Health Organization
F/Y	Fiscal year
HH	Household
Hiti	newari term for tap
HMG	His Majesty of Government
i.e.	that is
INGO	international non-governmental organization
KUKL	Kathmandu Upatyaka Khanepani Limited
LSMC	Lalitpur Sub-Metropolitan City
MLD	million litres per day
N.S.	Nepal Sambat (newari year)
NGO	Non-Governmental Organization
NGOFUWS	NGO Forum for Urban Water and Sanitation
No/nos.	Numbers
NWSC	Nepal Water Supply Corporation
p.m.	Post Meridian
SchEMS	School of Environmental Management and Sustainable Development
T.U.	Tribhuvan University
UN	United Nation
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nation International Children Education Fund
VDC	Village Development Committee
WAN	WaterAid in Nepal
WHO	World Health Organization
WSSB	Water Supply and Sanitation Board

## Symbols and units

Cl	Chloride
E-coli	Escherichia coli
Fe	Iron
NH <sub>3</sub>	Ammonia
NO <sub>3</sub>	Nitrate
PO <sub>4</sub>	Phosphate
%	Percentage
>	Greater than
km.	Kilometer
L	liter
mg	Milligram
ml	Milliliter
MLD	Millions Liter per Day
Rs.	Rupees
Sq. km	Square Kilometer

# Chapter I

## INTRODUCTION

### 1.1 Background

The world is facing a water crisis in recent years due to the economic and scientific development. Populations are growing and economies and lifestyles are changing, all adding to the stress on water resources. When the global population is being increasing by threefold the demand of water is being increased by six fold. The millions of world's poor, use less water, directly or indirectly, but depend upon its resources for their livelihoods for more than the well-to-do people. Yet, it is poor who are hit first and hardest when crises do come.

Human population in the past was small and sources of water were sufficient. So, requirement of water for drinking, bathing and cooking was enough with safe water. But as the population is increasing with the advancement of civilization, the utility of water enormously increased due to which the drinking water problem grew throughout the country.

In Nepal, rapid urbanization is growing in an alarming rate hence the demand of water for the respective uses particularly for consumptive uses like drinking water and irrigation is raising substantially. Approximately 15% of its total population are living in 58 designated urban areas. The urban population is increasing at the rate of 6.6% per annum. The urban population is expected to reach 23% by 2016. (WAN, 2007)

The majority of the stone spouts located in the LSMC are serving more than 30,000 families. (LSMC, 2007).

During the ancient period in Nepal, people used to worship the source of water and manage them according to the situations and circumstances. The Lichchhavi inscriptions of Basanta Deva, Saka Sambat 428, mentioned water keeping in a 'Guthi named "Paniya Gosthi"'. This 'Paniya Gosthi' used to managed the proper use of water in society and that would be well, pond, water spouts etc. in course of managing water, people established water stone spouts in society choosing proper location of settlement. (LSMC, 2007)

Current approaches to water management are highly segregated, focusing on technical improvements and sectoral solutions without sufficient attention to their basic social and sustainability goals. Recent research has shown that shifting the emphasis to the social base has major implications for strategy and the technologies employed. More technology is not always better. A reorientation of the technological approach may be more effective in delivering water services where they are needed, when they are needed, at a cost that is

realistic and acceptable, and with consideration of the larger time frame and scale necessary to ecosystem sustainability.

The following generally means, 'the current practices of improving water management system are focussed on technological improvement. But social and cultural aspects of water system (water sources) are equally important to ensure the sustainability of the sources and improve the system. Like in stone spouts and wells, there are various cultural aspects of the community (where they exist), are preserving the sources. People use these water sources for various religious activities such as morning rituals, etc. So, it's generally saying ' Too much technology is not always good for development'

## **1.2 Statement of the problem**

The shortage of water is already with the urban dwellers and it is certain that the harder time lies ahead. Drinking water has always been the greatest problem of the valley both quality and quantity wise. With water demand of 6 million litres/day within Lalitpur Sub Metropolitan City (LSMC), the supply is limited to 3 million litres/day in wet season and 2.5 million litres/day in dry season. As a result, people are still relying on traditional wells, stone spouts as their primary water source. (KUKL, 2008)

Present water demand of the valley is approximately estimated to be 240 million litres per day (MLD). The current supply is 190 MLD in wet season and 110 MLD in dry season (HMG, 2002). Leakage of 40% in the supply system has reduced the average per capita water supply. (KUKL). There has been a great water shortage despite higher willingness to pay of the residents. The alternative sources to meet the increased water demand have always been a matter of concern for the water experts of the nation. 'Melamchi Water Supply Project' is considered as the dream project of Nepal in drinking water supply sector and which is believed to suffice the valley dwellers with enough of quality supply. But its completion has always been ambiguous; the experience shows that Melamchi will not come in near few years.

While waiting for Melamchi, the traditional water sources like stone spouts, wells and springs could be used as auxiliary sources to fulfil the water demand. There are over 225 stone spouts in Kathmandu alone, 77 in Bhaktapur, 61 in Thimi, 53 in core city areas of Patan and 12 in Kirtipur excluding others in less populated areas (KUKL). Over 200 traditional wells are still in use in Patan. These are in a very sorry condition due to lack of conservation and management. A small attempt to conserve these spouts could be a great relief to the denizens of the valley in the dry season from November to June as the government's distribution of piped water falls short. These traditional sources could be conserved and managed only through the community-based approach as they are so much attached with the livelihood of people culturally, traditionally and religiously. The modern management system could remain insufficient because each community has their own value to look after their water systems. Thus, finding out the traditional elements

that have been able to interrelate the personal relationship with these traditional water sources, which are in the verge of extinction, could be significant tools for effective water management and thereby adequately improving water demand and sanitation & hygienic behaviours in the community.

### **1.3 Objectives**

The major objective of the study is to assess the sustainable elements of traditional water sources management. In addition to it, the study also has following specific objectives:

- To assess the existing situation of traditional water sources especially stone spouts
- To analyze the religious & traditional practices used for the water source management
- To assess the sustainability of traditional water management practices

### **1.4 Rationale of the study**

The total population of Lalitpur Sub-metropolitan City is 162,991 and total number of households is 34,996 (CBS, 2002). There are 32,468 taps installed in LSMC (Annual Report, KUKL, 2008). The total water demand to run these taps is 40 MLD and total KUKL supply is 32 MLD in wet season and 20 MLD in dry season. A gap of 8 MLD i.e. 25% in wet season and 20 MLD i.e. 50% could be seen in the supply and demand. Thus, it can be stated that there is a significant gap between the supply and demand of drinking water in the city.

It has been learnt that LSMC alone has 56 traditional stone spouts of which five are already extinct. The remaining number of spouts would be a better alternative water sources to meet the daily water demand of people in the present as well as in the future too, if conservation strategies are made and implemented now.

The significance of the study are:

- This study highlights the existing situation of the stone spouts and assesses some sustainable elements to conserve them.
- The results of the study aim to help the organization and local authorities to replicate successful management practices adopted by only few stone spouts.
- The study also illustrates few traditional ethics that is to be incorporated while planning for any community-based water supply system to make it sustainable.

### **1.5 Conceptual framework**

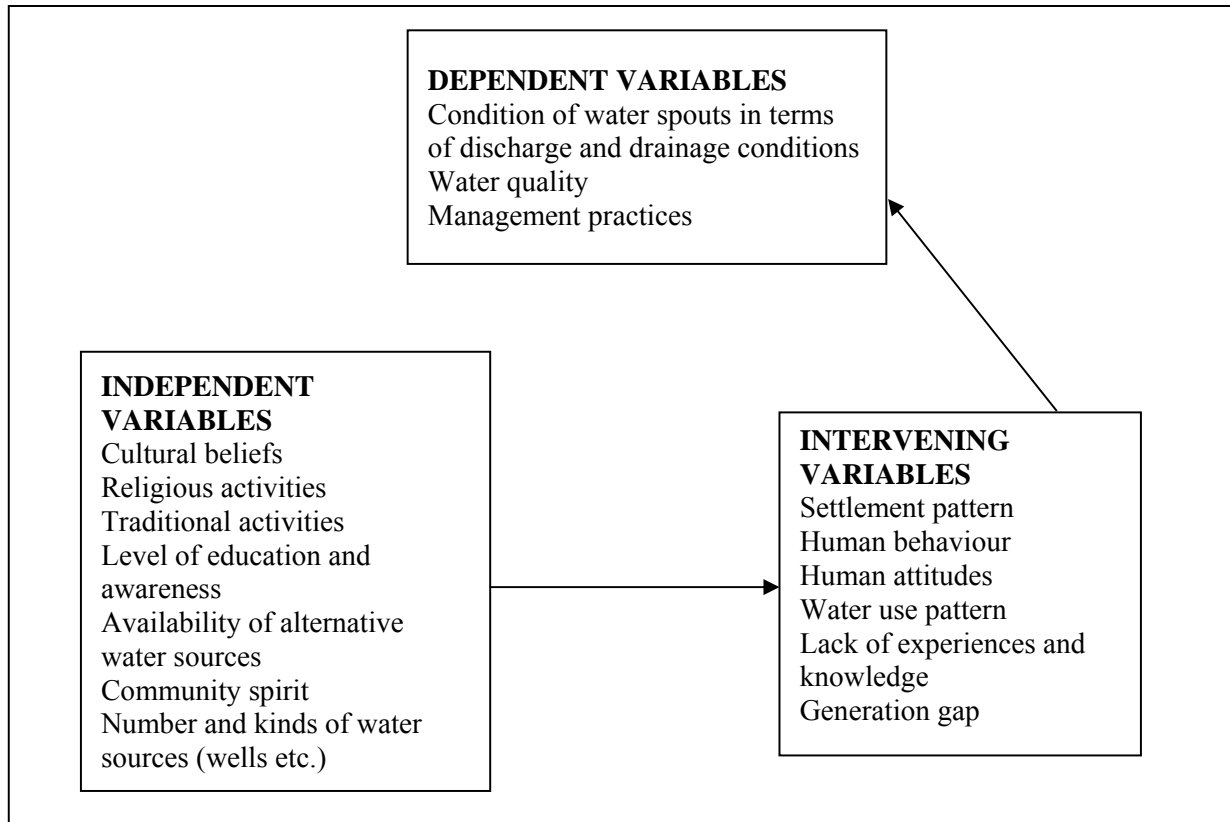
This section outlines the theoretical frameworks connecting all aspects of the research. It shows a simple map and guideline to form research questions. With the help of this

framework, research methodology such as survey, interviews analysis of existing data, direct observation has been aligned.

- i) Environmental Units:** Settlements surrounding the stone spouts and wells.
- ii) Dependent Variable:** The major objective of the study was to analyze the situation of the traditional water sources of LSMC and access the sustainable elements to conserve these sources. Thus, conditions of the spouts in terms of discharge and drainage condition, their water quality and management practices were considered as the dependent variables.
- iii) Independent Variables:** The sustainable elements of the traditional water sources were ensured by a number of independent variables such as the cultural beliefs of the community people, their religious and traditional activities, level of education and awareness, availability of alternative water sources, community spirit and number and kinds of water sources available in the surrounding. These variables were seriously studied through to find out the sustainability of water sources. The findings of dependent variables would give an impression whether the spouts can sustainably used for supplying drinking water in Lalitpur Sub-Metropolitan City.
- iv) Intervening Variables:** The effect of independent variables were limited by various intervening variables such as settlement pattern, human behaviour and attitudes, water use pattern, lack of experiences and knowledge and generation gap. These variables would regularly be affecting the dependent variables.

The figure 1.1 shows the interconnection between the dependent, intervening and independent variables on which the research is based upon. Independent variables and intervening variables contribute for dependent variables.

**Fig 1.1: Showing conceptual framework of the study**



## 1.6 Scope and limitation

The study has been conducted within LSMC only so it might not give situation of other regions such as that of Terai. Due the time constraint and limited financial resources, the study has been focused on limited number of sampling units and quality test of water in laboratory has not been performed by the researcher himself; secondary data of water quality test has been taken for the purpose. The study has focused especially on Newari women groups and older generations living around the water facilities. However, it is expected to fulfil its objectives within the available resources and time.

## 1.7 Organisation of the study

Chapter 1 of this study introduced the problem statement and described the specific problem addressed in the study as well as design components: background, problems, rational, objectives, and scope and limitation.



Chapter 2 presents a review of literature and relevant research associated with the problem addressed in this study. The chapter contains the study overview.

Chapter 3 presents the methodology and procedures used for data collection and analysis. The chapter contains rationale for selection of study area, sample unit and sampling method, types of data, tools, data analysis and statistical use, and anticipated outcomes.

Chapter 4 contains an analysis of the data and presentation of the results. The chapter contains stone spout basic introduction and technical specification, detail findings of each spout, interview with a committee member of 'Alko Hiti Conservation and Water Users Committee' which stand as an example of sustainable management practice, summary of findings, condition of stone spouts of LMSC, chemical and biological quality of water, water culture and discussion.

Chapter 5 offers a conclusion from researcher's findings, implications for practice, and recommendations for future research.

List of literature and relevant research documents the researcher referred while undertaking this study is included.

At the last section annexes are attached.

## Chapter II

### LITERATURE REVIEW

This section contains various facts and figures. In the course of the study, the researcher has referred to various literatures like research documents, reports and write-ups from various organisations and authors. This section has incorporated the key finding extracted for different literatures which has helped the researcher for broadening his understanding on the history of traditional water sources; different practices as well as different research those have already been done before.

#### 2.1 Overview

Water, because of its hydrological cycle, is a renewable but a finite resource and is one of the five essential elements necessary for human survival. The hydrological cycle generally implies the renewal of this resource where as the length of time between the completion of the cycle of its renewal vary greatly from one place to another. Water is also a mobile resource in the sense that after reaching to earth from the atmosphere, it moves over and under the earth's surface some eventually reaching to the ocean and some evaporating directly back into the atmosphere and some infiltrating into the underground storage. Between year 1900 to 2000, there is nearly tenfold increase in total water demand, whereas in the drinking water sectors the increment is 25 fold. Apart from living, in order to fulfil the daily domestic demand and personal hygiene, water is essential for people. Water is also important for food for irrigating land to increase productivity and to meet the ever increasing food demand due to the rapid population increase. To fulfil the ecological and biodiversity demand, the water for nature or environment, which was generally ignored in the past, has been one of the major concerns today. (Pyakural, 2004)

The population is expected to double in 30 years and hence the demand of water for the respective uses particularly for consumptive uses like drinking water and irrigation will rise substantially. Rapid urbanization is taking place in Nepal in recent years. Urban population grew from 4% in 1971 to 13.9% in 2001 and expected to reach 26.7% by 2021. Urban water demand is increasing rapidly at between 6 to 9% per annum – around three times the national population growth rate of 2.25% - thereby exerting heavy pressure on the existing, poor urban infrastructures including water supply and sanitation. (Tiwari, 2008) A careful planning is therefore essential for the use of the water resources that can be used in an optimal manner to meet the future water demand. As per the sector Ministry estimates, water coverage stands at 77% and sanitation coverage 46%.

Kathmandu, the capital of Nepal, is a metropolitan city with a population of more than 600,000. Water supply in this city has generally been short since the last 15 years or so.

With rapid population growth; about 15% the demand of water is also rapidly growing every year. The efforts of Nepal Water Supply Corporation (NWSC), the authorized organization for the supply and management of water supply, to promote the quality and quantity of supply, has been nullified during the last decade due to high demand growth. NWSC has very limited raw water resources within Kathmandu valley; high percentage of treated water is lost in the distribution system as leakage and wastage, further deteriorating the system supply. High percentage of leakage from distribution system due to the presence of very old pipes which have already lost their life. Physical and technical barriers make it difficult for equitable supply in all distribution areas. Thus, much remains to be done for better supply conditions. (Dhakal, 2004)

The total water demand in Kathmandu valley is estimated to be 240 MLD out of which the supply in the wet and dry seasons is 190 and 110 MLD respectively which shows a deficit of 50 and 130 MLD in the wet and dry seasons respectively, clearly showing the severe water scarcity problem. (KUKL 2008)

Kathmandu valley has nine water supply system that supply both surfaces (65 to 85%) and ground water (12 to 35%). KUKL is the responsible agencies for supplying water into the city area of the valley. The supply system covers almost 85% of the total population with 2 to 3 hours supply duration daily. The supply network is extremely complicated that expanded without any plans to meet the increasing water demand and expansion of the distribution area. Some of the pipe networks are as old as 100 years and has deteriorated significantly hence having high amount of leakage.

The traditional use of water sources has meant water for irrigation, drinking and domestic use, as well as life cycle and religious rituals, modern uses entail other functions such as for recreation, washing. It was only in the 1885 that Nepal entered the water development scene, first in the drinking water sector with the construction of Bir Dhara, mainly for the Rana residences and their surrounding (Sharma, 2001).

Water and Culture: water in cultural, religious and traditional philosophies and practices

- water is widely viewed as a god given resource: ‘Water is Life’.
- it is also widely regarded as a symbol of purification, holiness, and blessing, and is used for cleansing rituals in the main regional religions.
- although of great religious significance this can lead to major pollution, for example the ‘ghats’ in India.
- water is a symbol of power in Korea.

Pipe water technology was first brought to Kathmandu in the form of the Bir Dhara Works which was completed in 1891. For the general public, stand posts were provided at selected places. The designers claimed that these stand posts would provide clean water to the public and improve health conditions. Till the mid-twentieth century, cholera, typhoid and small-pox resulted in a high mortality rate in the valley. The health

of the people was made worse by poor sanitary conditions, the lack of education, poor nutrition and by the absence of preventive health services.

Bir Dhara provided private connections to Rana palaces and to the homes of the ruling elite. The system also supplied water to Phohora Durbar, a cinema hall and a stage for performing cultural programmes constructed in 1885. A series of fountains were installed in the garden and inside the building was a crystal fountain scented with rose water the many fountains provided the building with its name, Phohora Durbar (the Fountain Palace). The palace was sold, demolished and levelled in 1960.

As the population of Kathmandu increase, new water supply systems were laid. In 1928 the Tri Bhim Dhara system was built. To administer drinking water services Pani Goswara (the first water works office) was established in 1929. A few years later a hydroelectric power plant was built at Sundarijal. The water from the tailrace of the plant was tapped to supply the residents of Kathmandu. In 1972 Nepal received a loan from the World Bank to improve the drinking water and wastewater services in the city and a few towns outside of Kathmandu. This loan was followed by three additional loan packages. In 1974 the government established the Water Supply and Sanitation Board (WSSB). The Nepal Water Supply Corporation (NWSC) emerged as its new form in 1989.

As of 2000, the government had borrowed about one billion rupees to meet its objective of improving services in urban areas. Despite the investments, the quality of service is still poor. The pipe network covers a total area of about 50 sq. km in Kathmandu and Patan and comprises around 100,000 taps. In the majority of areas served, however, water is available for less than two hours daily. The quality of the water supplied is poor. The loan was used to lay sewer lines to collect and treat sewage, but since the treatment facilities never functioned as designed, wastewater is dumped untreated in the Bagmati and its tributaries, turning them into open sewers.

Recognizing that the level of drinking water supply services had not improved despite the investments, in 1987 the government constituted a three-member commission to review the urban water sector funded by the World Bank. The commission recommended that decision – making be decentralized to municipalities, that water loss be reduced and that the financial management of NWSC be improved. These recommendations were not implemented. In 1990 the government formulated a fifteen-year plan to improve the quality of service in the city's water supply and wastewater systems. In 1993 NWSC worked with South Stafordsire, a private company supplying drinking water and wastewater services in an English city, but this arrangement did not improve services either. Various modalities were tried to improve NWSC's performance, but the expected changes did not occur. In 1997, the government, as per the suggestions of lending agencies such as the World Bank and the Asian Development Bank, decided that the responsibility for management would be leased to a private company. However, the

responsibility of managing water supply in Kathmandu valley has recently been given to Kathmandu Upatyaka Khanepani Limited (KUKL).

The Rana rulers of Nepal, imitating Western lifestyles, introduced water supply technology in order to bring water to their palaces; no profit-making objective was present. Before the system was introduced, the people of the city were using stone water spouts (Dhunge Dhara), springs, ponds (pokhari), waterholes (Kuwa), rivers and dug wells (Inar) to meet their daily water needs. These are still used. Tap stands were provided from the pipelines as a 'gift' from the rulers to the common people (Sharma, 2001).

Traditional community based water harvesting is declining and being replaced by the role of government. This has led to wasteful and profligate consumption pattern in the country. Not only surface source but ground water sources are also being overexploited and polluted. Therefore, it has become necessary to receive community base water harvesting. This has to be done both in rural and urban areas. (Lal, 2004).

A study done by Mr. Kishore Kumar Jha confirmed that in the absence of adequate supply of water from the utility, people desperately look for other sources to supplement and meet their water needs. Almost one third of the city population, depend upon 'Own Source Supply' like shallow tube-wells and dug wells installed in their homes, though most of them tend to supply water containing iron, ammonia and microorganisms. The study further revealed that around one sixth of the city population is served by 'Community Managed Systems', which predominantly includes the age-old traditional system of stone spouts as well as community wells. People are used to getting free water from such sources. Not only the poor and lower medium income group but medium and upper medium income generating group also tend to access the community managed systems for water. (Jha, 2004)

Sustainability of any systems can be defined as the ability to maintain something undiminished over sometime period. The major goal of sustainable management is to maximize total long term benefits while conserving choice for future generations. Ecological sustainability means intersection of societal values and ecological capacity. The wise reinvestment of benefits derived from the utilization of the ecosystem provides a basis for ongoing sustainability of the resource. But if the utilization of the goods and services provided by the ecosystem is purely exploitive, a cycle of unsustainable use may be initiated. (Jewitt, 2002)

Ecologically sustainable water management protects the ecological integrity of affected ecosystems while meeting intergenerational human needs for water and sustaining the full array of other products and services provided by natural freshwater ecosystems. Ecological integrity is protected when the compositional and structural diversity and natural functioning of affected ecosystems is maintained. It is an iterative process in

which both human water demands and ecosystem requirements are defined, redefined and modified to meet human ecosystem sustainability now and in future, rather than a single one time solution. (Richter, et. al., 2003)

Some of the major challenges faced by the community-managed water systems are its increasing reduction in quantity of supply and deterioration of its microbiological quality. Lack of effective institutions and resources for repair and maintenance of the facilities, poses serious threats towards its sustainability. It is said that leakages from the dilapidated sewer network of the city pollute the unsealed underground channels of the stone spouts and wells. It was perceived that people are coming to terms of reality as reflected by their willingness to pay for services that were expected free of cost and considered a part of government's social service obligations. It was obvious that people are willing to support the concept of public community private partnership for enhancing the scope of community managed water systems and sustain the facilities.

The users of Maruhiti are awaiting some sorts of private initiatives, at least to initiate dialogues with the community. Those of Sinchahiti have gone a step further by pumping idle water of the spout to their homes, though inefficiently and in unorganized manner. Utility's initiative in Dhobighat to collect night flow into their storage tank for household distribution has shown a way for conserving water.

Some of the major constraints facing the community that have access to stone spouts are:

- Lack of financial resources with the community to optimize the use of natural water sources like stone spouts
- Lack of technical knowhow and sources with an individual community to ensure and safeguard the quality of water from the stone spouts.
- Lack of consensus within the community to manage the stone spouts. Socio-cultural believes can be considered as the constraint in this regard.
- There is no question of allowing anyone to collect Hiti's water in large volumes during the day. But Hiti's water could be collected at night and be distributed to individual houses as per the need. But, there is a common belief that a certain portion of Hiti's water should be allowed to flow free all the time and Hitis should not be completely tapped. Otherwise, as the elderly people believe, stone spout will become dry.
- The community believes that water from stone spouts have been supplied to the public free of cost for generations. So, it should not be used for commercial purposes. Similarly, the community itself should manage the system and they would not prefer even the government institutions like NWSC to take control of their Hitis.
- If some external agencies show interest to operate the Hitis then they should take the entire community into confidence which seems to be difficult.

Dhunge Dhara once met all the domestic water needs of the majority of Kathmandu's residents. The earliest Dhunge Dharas are still in use in Patan. It was built in 570 CE. Open conduits transfer water from springs and aquifers to taps located in a depressed rectilinear pit usually 10 to 30 feet below ground level. A survey in 2001 found 350 spouts in Kathmandu, Patan and Bhaktapur. In August 2001, 250 of them collectively yielded about 10 million litres of water a day. Their yield generally decreases by about two thirds in the dry months. Some of the taps provide good quality water, while that from others is of low quality. Many Dhunge Dhara have deteriorated due to poor maintenance. Others have been damaged by urban encroachment. The cities also had water tank systems called Jarhau. These vertical structures have small water tanks inside the spouts. Filled manually from the side, this arrangement served drinking water to travellers. Jarhau are in use in Bhaktapur and a few are used in Patan. (Dixit, 2002)

There are altogether 56 stone spouts in LSMC, out of which only 44 are functioning under natural source, 4 are completely dried up, 3 are submerged under water and 5 do not exist at all. Out of 11 sampled stone spouts, 10 are working under natural source and only one has been extinct. (NGOFUWS, 2005)

## **2.2 The dug wells**

Many dug well can be seen in the Kathmandu Valley. People are using the water for their domestic purposes. From traditional period, people have been using dug well. As an alternative water source, it is still used by the valley's people to fulfil their daily water need. Built with brick masonry wall, normally in circular shape, these wells collect water from shallow aquifer, normally 4 to 6 meters deep. Based on the water quality and depth of water in the well, some wells are very popular while others are used for secondary purposes like washing and cleaning. A rough estimate of more than 1000 such wells can be found in Kathmandu Valley. Unlike in gaa Hitias, dug wells are not directly linked with traditional ponds and canals, as they do not drain the water directly into the well. (UN-HABITAT, 2007)

However, infiltration of pond and canals are obvious from the drawdown of the well water after the recent destruction of ponds and canals. Focusing on stone spouts, this study will not be mentioning much of dug wells, which indeed require separate study.

## **2.3 The ponds**

Ponds were generally constructed to reserve the water to feed to the stone spouts and wells. The ponds are also part of landscape of Newar settlements beautifying the neighbourhood and providing open space to the clustered setting of the settlements. As per their location and thus the use, they may be categorised into ponds outside the settlements and ponds within the settlements. External ponds, especially those located in the higher elevation to the settlements are meant for recharging the aquifer as well as

serve as the reservoir for feeding irrigation canals. Lainchaur Pokhari, Rani Pokhari (Nhu Pukhu in Newari), Ikha Pukhu in Kathmandu; Siddhi Pukhu, Bhaju Pukhu, Nā Pukhu in Bhaktapur; and Lagankhel Pukhu, Paleswan Pukhu in Patan are the few examples of external ponds in the valley.

The ponds inside the settlements are relatively smaller in size. By function they serve as the places for washing, cleaning as a direct visible function, but support the settlements by providing buffer to the down pours during rainy season; and more importantly, helps to recharge the ground water particularly to local aquifers. Duck farming and grey water treatment are some of the auxiliary functions they serve to the neighbourhoods. Pako Pukhu, Khecha Pukhu<sup>4</sup> in Kathmandu and Tekha Pukhu and Khancha Pukhu are the examples for such ponds in Bhaktapur. In Lalitpur Pimbahal Pukhu is one of the best conserved ponds at present time. There are 39 traditional Pukhus in Patan alone (UN-HABITAT, 2007).



## Chapter III

### RESEARCH METHODOLOGY

Different types of method were used for undertaking the study. This section covers the study area, sample unit and sampling method, types of data, tools for data collection, data analysis and information used, and anticipated outcomes.

#### 3.1 Research design

The research study is both descriptive and analytical type. The research contained both qualitative and quantitative information and qualitative information were considered as of major concern. Based upon the descriptive and secondary data collected, analysis has been done by presenting in the form of tables, pie and bar diagrams.

#### 3.2 Rationale for the selection of the study area

The study on the assessment of sustainable elements of traditional water sources has been carried out in the core areas of Lalitpur district. This district has been selected because there are a number of traditional water facilities, especially stone spouts which are still in use extensively.

The area was selected on following basis:

- The Lalitpur district has a number of traditional water sources (stone spouts) which are still in extensive use.
- The area is exclusively inhabited by Newari community, a traditional group of people who still holds traditional and cultural ethos over these stone spouts. Therefore, the community would have a good knowledge of the spouts over the different period of time.
- The researcher itself is working in a development organisation which also works on conserving the traditional stone spout. So, he could have easy access to the information.
- The researcher lives and holding a job in the same city, thus it was easier and cost effective for him to collect information and visit the spouts as per the demand of the study.

#### 3.3 Sample unit and sampling method

Purposive sampling method and procedure have been adopted for this study. They are described as follows:

**Universe data:** There are altogether 44 existing stone spouts registered in survey list of LSMC in the core area of Lalitpur district. Therefore, these 44 stone spouts were taken as the universal data.

**Sample size:** Of the total universal data, visits and survey was conducted in 18 stone spouts (40% of the total number of the spouts). These stone spouts were selected on the basis of simple random sampling.

**Respondents:** Since the research basically is related to the traditional water sources, the target population was the one living near such sources. Thus, the type of sampling method used was the purposive one. Residents living near and surrounding the traditional water facilities, specifically the Newar female groups and elderly groups were interviewed. Discussion and interview was carried out with the key informants related to the water facilities and with the representatives of water users group.

### **3.4 Nature and types of data**

Both primary and secondary data that address the sustainability of traditional water sources was collected.

- i) Primary data:* For the collection of the primary data different tools mentioned were employed. Information gathered through direct interview with different respondents were taken. The respondents for the study were the local community people, representative of the stone spout management committee and clubs and the caretakers.
- ii) Secondary data:* The relevant secondary data was obtained from the different organizations such as Municipal Corporation, NGO Forum for Urban Water and Sanitation, WaterAid Nepal, TU library, web sites searching etc.

### **3.5 Tools for data collection**

Among the various tools developed for the collection of the data, the following three tools were applied for this study.

- i) Observation method:* This method was employed during the field visit to obtain the information on the conditions, cleanliness, and usage and construction materials. The direct observation of surrounding the spouts helped to judge its importance and effectiveness. This method also helped to cross check and control on validity and reliability of the information gathered from the respondents through interviews and scheduled table format.
- ii) Interview method:* For the collection of the data from the related personals from users committee, this method was followed. A number of personal interviews were conducted. Questions were asked formally in the face to face contact with these personnel. Indirect oral investigation was performed within the community surrounding the water sources to gather information relevant to the research objective.

iii) ***Schedule table format:*** This was the main tool for collecting data in the research. A scheduled table format including all the aspects of the study was prepared prior to field visit with the consultation and guidance from the supervisor. This included various parameters which were identified for the research. Around 20 photocopies of these formats were made to start the field visit. This has been filled by the researcher during the survey to note down the responses.

### **3.6 Data analysis and statistical use**

The research contained both qualitative and quantitative information and qualitative information were considered as of major concern. The data collected has been analyzed through simple statistics and has presented in the form of tables, and pie and bar diagrams. Interpretation of the qualitative data collected through observation has been done by researcher's point of view and a direct interview has been presented in text box.

### **3.7 Anticipated outcomes**

The study expected to provide the following outcomes:

- General picture of traditional water sources
- Religious and traditional practices which would help to conserve the sources
- Peoples willingness to use the sources over the modern systems
- Adaptability of the traditional water systems
- Sustainability of the water systems in terms of different elements

## Chapter IV

### ANALYSIS AND INTERPRETATION

This chapter is based on the findings of the research. Based on the findings, data has been processed and analysed. The interpretation of the data is based completely on the researcher's point of view.

#### 4.1 A brief introduction of Stone Spout at a glance

Stone Spout is a form of traditional water source before the modern water supply system was existed. The stone spout receives water from either an individual spring or nearby aquifer. The aquifers are largely dependent on rainwater. Therefore, the water table in shallow aquifers may cause some stone spouts to yield less or become dry during the dry season and flow only during the rainy season.

#### 4.2 A brief introduction to the mechanism of stone spouts at a glance

Stone spouts are beautifully carved stone elements, in the shape of a crocodile head (considered as a holy water animal - the carrier of the Goddess *Ganga*) or serpent head, installed in the front or side walls of sunken and stepped platforms for the purpose of channelling water for human use. Each platform, or *Hiti*, may contain one or more spouts. The spout(s) projects about 20 cm to 50 cm from the wall in which the spout is installed. The platform is usually constructed of stone slabs or bricks paved with mortar and fitted with a shallow overflow or drainage channel (generally provided with an iron screen). The surrounding wall is of brick masonry. Stone sculptures, idols and images of gods and goddesses are laid over and under the spout(s), on the surrounding wall and elsewhere in the compound. Despite their age, the underground supply and drainage lines of many old systems are still functioning, nobly characterizing the technical and engineering skills of the ancient people of Nepal.

The supply of water to the *Hitis* depends both on ground and surface water. Most stone spouts receive water from either an individual spring or nearby aquifer. A single aquifer may supply water to one or many stone spouts. The stone spouts may be located within a particular, defined aquifer of known extent, or, more often, within aquifers whose locations and extent are unconfirmed. The aquifers are largely dependent on rainwater for recharge and maintenance of the groundwater table. Draw down of the water table in shallow aquifers may cause some stone spouts to yield less or become dry during the dry season. Some stone spouts only flow during the rainy season and remain virtually dry in other seasons.

To provide a continuous and uninterrupted supply of water from the stone spouts, a porous brick chamber is usually constructed surrounding the location of the underground

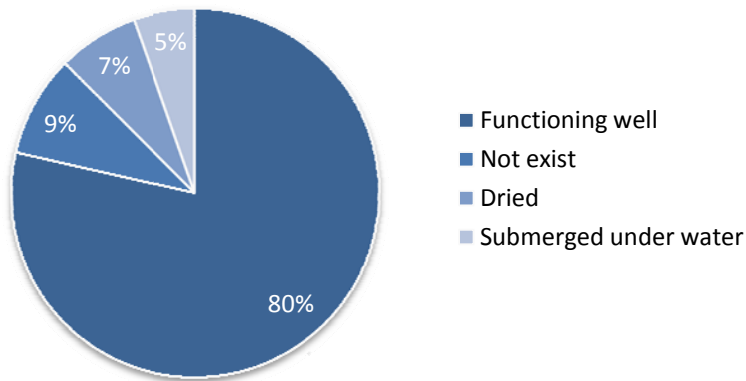
channel from the aquifer. The porous base and the surround of the chamber provide stability to the channel and protect it. The supply line is made of brick, timber or clay or a combination of these materials. The timber used in the supply line is generally grooved in a lengthwise direction, and brick or timber planks are used as lids to cover them. To avoid contamination of the underground supply by the entry of surface water, sewage or other contaminants through suction, percolation or seepage into the supply lines, the supply lines, and especially the joints, are carefully covered with clay or red soil of limited permeability. The supply lines are generally located between 1 m and 5 m below the ground surface. The supply lines are sloped to maintain the flow of water.

Detail findings of observation and sharing done in the niche of stone spouts.

### 4.3 Conditions of the stone spouts of LSMC

During summer season, most of the stone spouts dries up or yield low water discharge. As the main source of water supply to these spouts are the nearby aquifer and ponds which dries for three to four months during summer season. The majority of the stone spouts are located in the settlement areas serving more than 30,000 families. (LSMC, 2007).

**Figure 4.1: Condition of the stone spouts of LSMC**



**Table 4.1: Status of the stone spouts of LSMC (summary)**

S.No	Status	Number	%
1.	Functioning	44	79
2.	Not exist	5	9
3.	Dried	4	7
4.	Submerged under water	3	5
<b>Total</b>		<b>56</b>	<b>100</b>

(Source: NGOFUWS, 2005)

The above figure shows that out of the total 56 stone spouts of LSMC, 79% of them are functioning under natural source, while 9% do not exist, 7% are completely dried up and, 5% are submerged under water.

This shows that most of the spouts are still functioning well and people are using them. The reason behind their sustainability must be the good management practice which was observed during the survey. The other reason must be the cultural and traditional value the spouts hold.

The table 4.1 shows the operational status of the stone spouts of LSMC.

**Table 4.2: Status of the stone spouts of LSMC**

S. N	Name of Spouts	Status
1.	Alko Hiti *	Working under natural source
2.	Amirt Hiti *	working under natural source
3.	Bagdole Hiti	working under natural source
4.	Bhandarkhal Hiti	Dried
5.	Bhindhyolachhi Hiti	Dried
6.	Bhola Hiti	Submerged under water
7.	Bholakhel Hiti	working under natural source
8.	Byan Hiti *	working under natural source
9.	Byanchha Hiti	working under natural source
10.	Chhya Bahal Hiti *	working under natural source
11.	Chyasa Hiti *	working under natural source
12.	Dathu Hiti	working under natural source
13.	Dhola Hiti	working under natural source
14.	Elhane Hiti	Submerged under water
15.	Guita Hiti	Submerged under water
16.	Hiku Hiti *	working under natural source
17.	Iku Hiti *	working under natural source
18.	Jawalakhya Hiti	working under natural source
19.	Kal Dhara	working under natural source
20.	Kani Baha Hiti *	working under natural source
21.	Konti Hiti *	working under natural source
22.	Kwachhen Hiti	Dried
23.	Kwonti Pukhu Hiti	working under natural source
24.	Kwonti Hiti	working under natural source
25.	Lagankhya Hiti	working under natural source
26.	Magah Hiti	working under natural source
27.	Manga Hit	working under natural source
28.	Mani Mandap Hiti	working under natural source

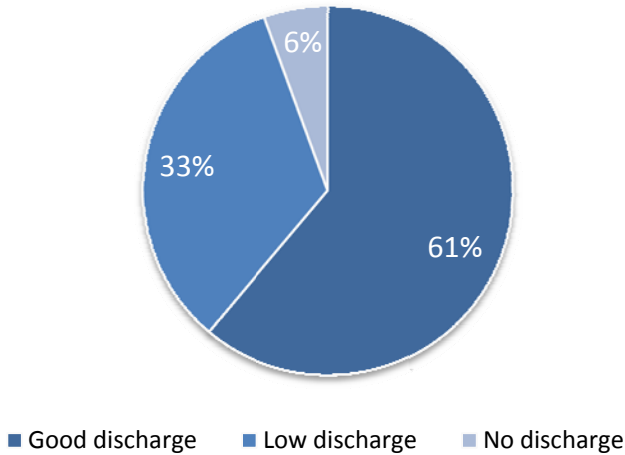
S. N	Name of Spouts	Status
29.	Minsha Hiti	working under natural source
30.	Nakhipot Hiti	working under natural source
31.	Naran Hiti *	working under natural source
32.	Naricha Hiti	working under natural source
33.	Natwa Hiti	working under natural source
34.	Sundhara Hiti (Nugha Hiti) *	working under natural source
35.	Nyagachhyo Hiti	working under natural source
36.	Pattipa Dhara	working under natural source
37.	Pulchowk Hiti (Pucho Hiti) *	working under natural source
38.	Sankhamul Hiti	working under natural source
39.	Sauga Hiti	working under natural source
40.	Shova Hiti	working under natural source
41.	Sin Hiti	working under natural source
42.	Sincha Hiti *	working under natural source
43.	Sitha Hiti *	working under natural source
44.	Subaha Hiti	working under natural source
45.	Tanga Hiti	working under natural source
46.	Taapaa Hiti *	working under natural source
47.	Thapah Hiti *	working under natural source
48.	Tikhideval Hiti	working under natural source
49.	Tusa Hiti	Dried
50.	Tyagal Hiti *	working under natural source
51.	Washa Hiti *	working under natural source
52.	Nabahil Hiti	Not exist
53.	Pilanchhen Hiti	Not exist
54.	Swoti Hiti	Not exist
55.	Kupondole Hiti	Not exist
56.	Bahila Hiti	Not exist

\* Stone spouts that were taken for study  
(Source: NGOFUWS, 2005)

#### 4.4 Water discharge

Most of the stone spouts of LSMC lie in the Patan area. As this is highly population dense area, there has been difficulties in channelizing proper water supply line of NWSC, as well the reality is also that the water supply is not able to meet the demand, most of the population has had to rely upon these traditional water sources.

**Figure 4.2: Water discharge of the stone spouts of LSMC**



**Table 4.3: Water discharge of stone spouts**

S.No	Period	Number	%
1.	Good discharge	11	61
2.	Low discharge	6	33
3.	No discharge	1	6
<b>Total</b>		<b>18</b>	<b>100</b>

*(Source: Field survey, 2009)*

The above figure shows that out of the 18 sample taken, 61% of stone spouts in LSMC have good water discharge, while 33% have low discharge and 6% are completely dried up.

This shows that 61% of the spouts are functioning with good water discharge. 6% of the stone spouts have dried. This shows that since the study done by NGOFUWS in 2005, 6% of the stone spouts have dried up. 33% of the stone spouts are giving low water discharge.

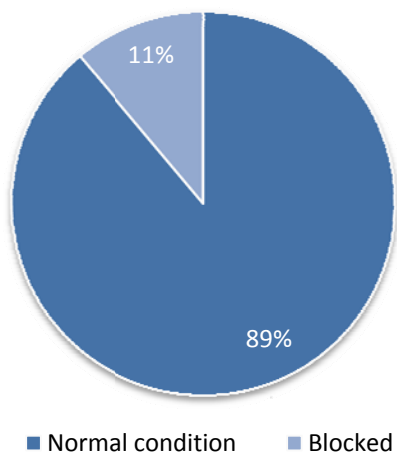
The government has no any policy for ground water use. Due to rapid urban growth and insufficient water supply from the government, people started extracting water from the ground through dug wells and hand pumps. Construction of building over the water supply channels of the stone spouts, private dug wells and hand pumps has disturbed or damaged the water channels underneath the ground. Industrialization in the city areas is yet another biggest problem for drying up these traditional water sources. Huge amount of water is extracted from the ground which has resulted to low discharge or completely drying up the stone spouts. We can take an example of Sundhara Hiti at Patan area. The amount of water flowing through Patan Sundhara Hiti decreased when Patan industrial estate began drawing excessive amount of water from the wells located on its premises.



In the past, there were many ponds in Kathmandu valley for reserving the water. Lagankhel pokhari and Kamal pokhari were two among such ponds which used to reserved the water and provide to the stone spouts through the underground water channel system. Unfortunately, none of these ponds now exists there except huge buildings.

There has not been a good practice of ground water recharge. KUKL extracts huge amount of ground water for regular supply to the Kathmandu Valley. But they do not have the mechanism for recharging the ground water which has significantly contributed in decreasing the ground water table.

**Figure 4.3: Condition of drainage system**



**Table 4.4: Condition of drainage system**

S.No	Drainage condition	Number	%
1.	Normal condition	16	89
2.	Blocked	2	11
	<b>Total</b>	<b>18</b>	<b>100</b>

*(Source: Field survey, 2009)*

The above chart shows that out of the 18 sample taken, of 89% of the stone spouts have drainage system in normal condition and only 11% are blocked.

11% of stone spouts have their drainage system blocked. The drainage system should be well managed as this will degrade the surrounding environment and pollute the ground water.

#### 4.5 Component and structure of stone spout

Within the stone spouts' premises, we can observe unique features of artistic creations of Nepalese architecture which holds religious values. The spout itself is made of stone with Crocodile shape. The Vamana Puraoa referes to a Crocodile as the conveyance of lord Varuoa, the mythical king of water. As mentioned in the tang annals by Wang Hsuan Tse, there is a palace called Kailaskuta Bhavan built by kind Amuvarma in which there are golden dragons which spouts forth water streaming like a fountain from the mouth of the golden makara (crocodile). There is another legend in which it is said that the water fluens from the spring to the tap by the blessings of Vasukinaga, the king of waters. He is one of seven Naga who holds up the earth. Mentioned in the copper plate inscription of Alukoevahity at Patan, is made of eight kinds of Dhungedharam, bearing the figure of 1. Gomukha Naga (serpent with the Cow head shape) 2. Megha Naga (Black colored serpent) 3. Simhamukha Nama (Head of a lion shaped serpent) 4. Byaghrasukha Naga (Tiger's head shaped serpent) 5. Mgamukha Naga (Head of antelope shaped serpent) 6. Gajamukha Naga (Head of elephant shaped serpent) 7. Bhujangamaha Bksa Naga (Tree shaped serpent) 8. Bhujakhala Naga (Head shaped serpent). In all these, the Nagas (Snakes) are used as symbols of water. Beside these, carving and statues of different God and Goddess are kept in the premises for the purpose of keeping the area clean while doing various religious activities such as morning rituals, etc. (LSMC, 2007)

#### 4.6 Construction period

Figure 4.4: Period of establishment of stone spouts

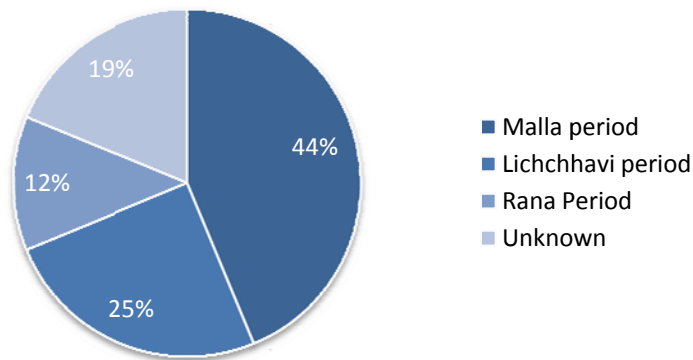


Table 4.5: Period of establishment of stone spout

S.No	Period	Number	%
1.	Malla period	7	44
2.	Lichchhavi period	4	25
3.	Rana period	2	13
4.	Unknown	3	19
<b>Total</b>		<b>18</b>	<b>100</b>

(Source: Field survey, 2009)

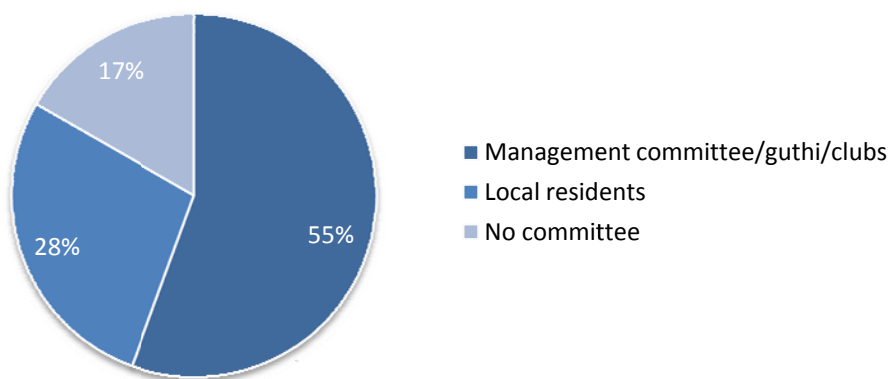
The above figure shows that out of 18 sample spouts, 44% of them were constructed during Malla period, 25% were constructed during Lichchhavi period, 13% were constructed during Rana period, and 19% are unknown.

This figure shows that most of the stone spouts exist today were constructed during Malla period. Lichchhavi period being the oldest period had constructed the stone spouts but during the Malla period the continuation of stone spout grew up. During the Rana and Shah period mostly their conservation and renovation were done.

#### 4.7 Management of the stone spouts

Management of Stone Spouts is one of the major elements for its sustainability. Some of the spouts like Alko hiti, Thapa hiti and Sancha hiti are doing well management practices which are in excessive use and serving thousands of people of surrounding settlements. For many people this is the only source of drinking water.

**Figure 4.5: Management of stone spouts**



**Table 4.6: Management of stone spouts**

S.No	Managed by	Number	%
1.	Management committee/ guthi/ clubs	7	56
2.	Local residents	4	28
3.	No committee	2	17
<b>Total</b>		<b>18</b>	<b>100</b>

*(Source: Field survey, 2009)*

It can be observed that 56% of the stone spouts located in LSMC have some kind of management body to take care of. These institutions are in the form of management

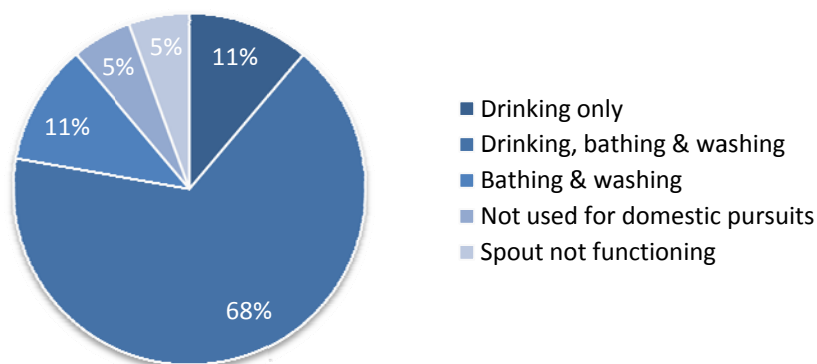
committee, guthi and clubs. It can also be observed that 28% of stone spouts are managed by the local residents and 17% has no any committee to take care of.

Therefore, it can be seen that most of stone spouts have management committee or local residents to take care of. The stone spouts which has a management body, the water is wisely utilized while timely observation and proper maintenance is done. Hence, a good management committee plays an important role for the long term sustainability of the traditional water sources.

#### 4.8 Use of stone spout

The majority of the stone spouts located in the LSMC are serving more than 30,000 families. (LSMC, 2007). For them these traditional water sources are the only source for drinking and other domestic pursuits.

**Figure 4.6: Use fo stone spouts**



**Table 4.7: Uses of stone spouts**

S.No	Uses	Number	%
1.	Drinking only	2	11
2.	Drinking, bathing and washing clothes	12	67
3.	Bathing and washing clothes	2	11
4.	Not used for domestic pursuits	1	6
5.	Spout not functioning	1	6
	<b>Total</b>	<b>18</b>	<b>100</b>

(Source: Field survey, 2009)

It can be observed that 67% of the stone spouts are used for drinking, bathing and washing purposes. Whereas, 11% are used for drinking purpose only, 11% are used for bathing and washing clothes only, 6% are not used for any domestic pursuits and 6% of the spouts are not functioning at all. The stone spouts which are not in use for domestic pursuits is because of people not feeling comfortable to use the water as it is not of good quality. It was also observed that in some stone spouts washing and bathing is prohibited and allowed for drinking purpose only. Since such stone spout has large queue for

collecting water and due to limitation water supply, bathing and washing is prohibited. In such case, people use another spout nearby for bathing and washing purposes.

#### **4.9 Typical use of stone spout**

Beside regular use of stone spouts for drinking, bathing and washing, people also use them for other typical purposes such as performing daily praying and morning rituals, worshipping snakes and deities located inside the spouts' premises and cleaning during various Hindu festivals.

Table 4.2 summarize the findings of the study. The same format was used during the survey. The main purpose of the survey was to generate qualitative information so various open-ended questions were asked based on the format.

**Table 4.8: Summarization of findings of visited stone spouts**

SN	Stone Spouts	Water discharge/condition	Components	Constructed on	Operation and Maintenance	General use	Typical use
1.	Pulchowk Hiti	Very low discharge of water, water quality not good, drainage working normally	Crocodile shaped spout, Sarashwati, Buddha, Kalas, Naga, Barun and Bhagirath are under the stone spout.	Malla period	No committee	Not used for any domestic pursuits	People worship Naga (Snake) inside the hiti and cleaned during 'Sithi Nakha'
2.	Chhay Bahal Hiti	1 spout flowing with good quality water, drainage slightly blocked	Two crocodile and one lion faced spout, Ganga, Umamaheshwor, GarudNarayan, two Arshi and Bhagirath under the stone spout	Malla period	No committee	Water used for drinking, bathing and washing	Cleaned during 'Sithi Nakha' and perform daily morning rituals
3.	Chyasa Hiti	8 spouts flowing with good quality. Some spouts dry during summer session	Umamaheshwor 2, Surya 1, Devi 1, Ganesh 1, Buddha 2, Laxminarayan garud 4, Chaturmukha Shivalinga 1, Bhagirath 4, Bramha 1, Chaitya 2, Jaldroni 1, Sarashwoti 1 and Bell 1	Unknown	Chyasaal Hiti management committee	Mainly used for washing and bathing	Worship during Yanya Punhi. Cleaned during 'Sithi Nakha' and perform daily morning rituals
4.	Sundhara Hiti	Four spouts are flowing with good quality water, drainage is in normal condition	3 Golden plated Crocodile spout and 1 Ox, lion, crocodile	Lichchhavi period	A club 'Prabhat Pariwar' manages and collects fund	Water used for drinking, bathing and washing	Water used for worshipping Matchhendra Nath chariot festival and for

SN	Stone Spouts	Water discharge/condition	Components	Constructed on	Operation and Maintenance	General use	Typical use
							morning daily rituals
5.	Sincha Hiti	Three spouts flowing with good quality water, drainage is in normal condition	1 Crocodile shaped and 2 simple shaped spout,	Malla period	Managed 'Sincha Hiti Tole Sudhar Samiti' and it collects Rs 100 from its member every year	Water used for drinking, bathing and washing	Cleaned and worship during during 'Sithi Nakha'
6.	Thapah Hiti	Three spouts are flowing with good quality water, drainage is in normal condition	Crocodile ( <i>Makara</i> ) shaped spout, Chaitya 1, Narayan 1, Buddha 2, Umamaheshwor with Gana 1, Shiva ling 1, Bagirath 2,	Lichchhavi period	Managed by Thapa Hiti Sanrkchhyan Samiti and it collects Rs 100/year from users	Water used for drinking, bathing and washing	Cleaned and worship during during 'Sithi Nakha'
7.	Tyagal Hiti	One spout flowing with good quality water, drainage in normal condition	Crocodile shaped spout, Shiva Linga, Laxmi Narayan, Narayan, Bhagirath, Unidentify image like Uma Maheshwor	Malla period	Local Maharjan Guthi	Water used for drinking, bathing and washing	Celebrated Yana Punhi in the spout
8.	Kani Baha Hiti	One spout which is not flowing, drainage is blocked	Crocodile shaped spout, Ganesh 1, Buddha 1, Bhagirath 1	Malla period	No committee	Nobody uses the spout	Worshiped during Nag Panchami and Sithi Nakha festival
9.	Iku Hiti	Five spouts flowing with	3 Crocodile and simple	Malla period	Iku Hiti water	Water used	Worshipped

SN	Stone Spouts	Water discharge/condition	Components	Constructed on	Operation and Maintenance	General use	Typical use
		good quality water, drainage is in normal condition	2 piped spouts, Bishnu 1, Asan Bisnu laxmi 1, Sthanak Bishnu laxmi 1 and Bhagirath 1		users committee, selling water and collecting funds	for drinking, bathing and washing	during Lagankhel jatra
10.	Hiku Hiti	Three spouts flowing with good quality water, drainage in normal condition	Crocodile shaped spout, Ganesh 1, Narayan 1, Shiva Parvati 1, Bhagirath 1 and Jaldroni 1.	Unknown	Hiku Hiti water user committee, collects fund from private households and dhobis	Water used for drinking, bathing and washing	Cleaned and worship during during 'Sithi Nakha'
11.	Alko Hiti	Five spouts flowing with good quality, drainage condition is normal	4 crocodile and 1 tiger shaped spout, Siva ling with temple 1, Shikar style with Narayan and Umamaheshwor 1, Lichchhavi period Chaitya 6, Buddha images 4 Bishnu 2,	Constructed during Malla Period on 1415 AD	Manages by Alko Hiti Conservation and Drinking water Users Committee	Water used for drinking, bathing and washing	Cleaned during Sithi Nakha and celebrated Indrajatra
12.	Taapaa Hiti	Out of three spout one is flowing with good quality water and rest of the two are not flowing. People directly drink the water.	1 Crocodile shaped and 2 simple shaped spout. Idol of Umamaheshwor 1, Narayan 1, Shiva ling 1, Annapurna 1 and Ox 3.	Lichchhavi period	Local residents	Drinking only	This spout is used in the daily praying and worshipping of deities located inside the hiti premises.



SN	Stone Spouts	Water discharge/condition	Components	Constructed on	Operation and Maintenance	General use	Typical use
13.	Washa Hiti	One spout flowing with good quality water flow, drainage in normal condition	Makara headed shape and 1 ox headed shape. Idol of Umamaheshwor and Bhagirath	Rana period	Local residents	Mainly used for bathing and washing clothes	Worshipped regularly while bathing and also during Sithi Nakha. Rana people used to use water from this spout in purpose of medicine.
14.	Sitha Hiti	One tap with minimum water flow	Makara headed shape. Idol of Narayan and Bhagirath	Rana period	Local residents	Drinking purpose	Cleaned and worship during during 'Sithi Nakha'
15.	Amrit Hiti	Two spouts, Water is flowing less due to installation of well around. The water dries during the dry season. Drainage in normal condition.	Makara headed shape. Idol of Bishnu with Laxmi and Garud	Malla period	Managed by Imukhel conservation committee	The water is used for drinking, washing and bathing.	Cleaned and worship during during 'Sithi Nakha'
16.	Konti Hiti	Out of six taps, three has dried up from this year as dry season started. This hiti had never dried before.	Lion headed shape. Idol of Umamaheshwor	Lichchhavi period	Managed by Kumbeshor Management Committee. Collects money	Drinking, bathing and washing clothes	Kumbeshwor festival observes during the Janai Purnima

SN	Stone Spouts	Water discharge/condition	Components	Constructed on	Operation and Maintenance	General use	Typical use
					from households and supplies water through a supply system.		in premises of this stone spout
17.	Naran Hiti	Three taps. Only one is flowing with very less water.	Markara headed. Idols of Gajalaxmi 1, Buddha image 1, Jaladroni 1, Shivaling 1 and Balaram 1.	Lichchhabhi period	Managed by local residents	Drinking, bathing and washing clothes	Daily worship and cleaned during Sithi Nakha.
18.	Byan Hiti	Two spouts. Only one is flowing with very less water but still nobody use the water as the water is yellow in colour.	Markara headed. Idol of Jaladroni.	Unknown	Cleaned by local residents	Drinking, bathing and washing clothes	No any religious activities done. Cleaned during Sithi Nakha.

#### **4.10 Detail findings of observation and sharing of stone spouts**

The major findings of the research helped to define sustainable elements as relatively long life span of water facilities which should meet the requirement of users and should be environmental friendly, maintained and operated easily and at low cost, should be adaptive to changing environment and efficient. These elements are explained extensively below.

**1. Pulchowk Hiti:** It lies in ward no. 3 Pulchowk and believed to be constructed in Malla period. It has two spouts of which only one is flowing, that are also in very low discharge and water is not potable and it stinks; local people no more use water from the spout only few of the small tea shops uses water for washing dishes. The source of this spout is located at Khwayebahi. The discharge has lowered since seven years. In the old days, there used to be high discharge and it used to accumulate forming pond and water was potable. Female group called as Maa: Puja has been cleaning the platform of the spout during Sithi Nakha festival. Otherwise there was never a committee formed to conserve and maintain the spouts. It was stated that due to construction on well in the nearby building which is just 3m away from the spout has affected the discharge and water quality of the spout. Other building along the same line also has dug well to dry the spout. Local people used to come to wash their face in the morning and perform their daily rituals in the spout. Cement work has been done in the stone spouts and drainage system is working normally.

**2. Chhay Baha Hiti:** It lies in ward no. 21, Chaaybahal. It has three spouts of which only one is flowing with relatively high amount of water, other two has stopped flowing since 30 years. The reason stated by the local people is due to inadequate supply of water at the source. Water quality is good and odorless. The location of source for this spout is Khwaya Bahi. More than 100 families are using water from this spout for drinking, washing and bathing, most of them are renters who could not suffice their water demand with less supply from their house owner. Spout is constructed with decorated bricks and modern bricks, stone pavement on the floor and cement work on the plinth and wall. Drainage system has been slightly blocked and the ground is covered with weeds. The spout has outlets known as 'Mangal' in several places which has now been captured by local households which is not cleared up, few of them even have buried, according to local people. The spout is located at Chhaya Ba joint with Chhya Bahal gate which is considered as main route for trade, in those days. An eighty seven years old lady told that the spout has been supplying water since the period of Prime Minister Jhudda Shamsheer Rana. Local people come to wash their face in the morning and perform their daily rituals in the spout. Women's group for Lalitpur Municipality has cleared the grasses grown on the ground on Sithi Nakha. Tole dwellers also cleared the spouts by collecting money from the users but very rarely.

**3. Sundhara Hiti:** It lies in ward no. 7 in Sundhara and constructed during Lichhavi period. It has four flowing spouts with good and odorless water. More than four thousand people from surrounding area visited the spout daily to collect drinking water, according to a local people. Previously, water was used for washing and bathing too but due to low discharge since few years, washing and bathing has been prohibited after 5 a.m. and before 8 p.m. The drain condition is normal. The spout has been constructed uniquely with pital and jalap of gold. Legend is that a man went to meditate in Phulchowki Mai in order to do social work. Pulchowki Mai being happy gave him a stone to construct spout on the roof of his house. It is believed that the spout had constructed on the roof of the house, so it could be seen today also built in the same level of road. Local people worship it as daily rituals. On the occasion of Matchhendra Nath chariot festival, the image of Machhendra Nath is kept at the back side of Pati and water from the spout is used for worship. The local Guthi worship the spout to celebrate its birthday yearly. 'Prabhat Priwar', a local club of tole dwellers is managing the spouts. The club collects Rs. 100 per year from users, Rs 5 daily from local fruit and vegetable sellers and from the rent of Prabhat house. The spout has temple and a beautiful garden at the back side which are acting as conservation measures.

Most recently, locals of Sundhara who rely on water spouts to meet their demand of water have been facing a shortage of water. They say the amount of water flowing through Patan Sundhara stone spouts decreased when Patan Industrial Estate began drawing excessive amount of water from the wells located on its premises. According to them, Nayakhel, a ground which lies a kilometer away from Sundhara, is the source that feeds water to the spouts. Water flow becomes irregular when the industrial estate, which is situated next to Nayakhel, begins to drawing water. The flow of water is smooth when industrial estate is not drawing water on holidays. Decision and consensus still needs to be made among the parties -locals and the industrial estate.

**4. Sincha Hiti:** It lies in ward no. 17 in Sincha Hiti tole. It was constructed during Malla period. It was renovated in 2055/56 B.S. jointly by UNESCO through the municipality and local people and the total cost of renovation was Rs. 1,60,000 of which 20% was contributed by the local people. It has three spouts which are flowing sufficiently with good quality water, used for drinking, bathing and washing. Source of this spout is Naye Khyo aquifer. More than 500 families living in the surrounding area uses the spouts and most of them are renters. The spouts often dry up in winter season. There an interesting legend about the spout; a person meditated the Phulchowki Mai in Phulchowki in order to do a good work in the society. The Phulchowki Mai was pleased with him and gave him three stones to make stone spouts. His wife, unknowingly, throw these stones in three different places of Nuga tole and Sincha tole where gradually originated three spouts named as Mangal Hiti, Saugal Hiti and Sincha Hiti. The source of the spout is same as the Sundhara Hiti, overflowed water from Sundhara Hiti flows through this spout. The source lies nearby in the private open land which was planned to sell but the local didn't allow and now it has been forbidden to sell or perform any construction work. The outlet

of the spout is in good condition and flows through paddy fields nearby. A locally formed committee named as 'Sinha Hiti Tole Sudhar Samiti' formed in 2057 is responsible to look after and manage the spout and collects Rs 100 per year from the members as fund. The community residing in the Sincha Hiti tole is not more than 25 years old and it is a heterogeneous community. As such the committee is finding difficulty to manage the spouts as the users disobey the rules of the hiti. Though there was a collection bin kept in the spouts to dispose soap wrappers and plastics, numerous amounts of them could be seen thrown haphazardly.

**5. *Thapah Hiti:*** It lies in ward no. 6, Thapat tole which is believed to be constructed during Lichhavi period. It has three flowing spouts and water is used for drinking, bathing and washing. Source of this spout is unknown. Water quality is good and odorless. Renters are highly dependent on water source to meet their daily water demand and house owners come to fetch pristine water during morning for daily rituals. In 2016 B.S., spout completely dried up due to breakdown in pipeline. Then, a local people had direct link in the ministry and so, the problem was solved by installing new pipeline from the source to the spout. Another history goes like this; in 2019-20 B.S. a snake was seen in the spout and people afraid to take water. It disappeared only when the local people worshipped to Phulchowki Mai. The outlet of the spout is in Saugal hiti, another stone spout. 'Thapa Hiti Samrakchhyan Samiti' has been formed two years back with eleven members to look the management of the spout and ever since the committee has been working actively. Each household contributes Rs 100 per year for the maintenance of the spout. Recently, about three lakhs rupees have been spend to clear the outlet. Municipality promised to contribute Rs 1,32,000 and ENPHO, an NGO contributed with Rs 1,50,000 along with local contribution of Rs 41,000. Though the work has been completed, municipality has supplied only partial amount of money. This shows irresponsiveness of municipality towards its own promise and created dishonesty and unreliability towards its work. The committee need not have to wait for Sithi Nakha to clean the spout; they clean it whenever in their leisure time. A new source has been found for the spout which needs to maintain and the committee are looking for support from related organizations. The local older generation is teaching the coming generation about different aspects of the spouts such as its outlet pattern and location of the source. It is hoped to be in use for next 70 or 80 years if the coming generation give as efforts as it is given.

**6. *Tyagal Hiti:*** It lies in ward no. 7 in Tyagal which is constructed during Lichhavi period. It has one spout flowing with good quality water but with small discharge. The source for this spout is located at Bhinchhebaha. The discharge has been lowered since 15 to 20 years due to construction of buildings around the spout which prevented infiltration of rain water and drying up of source. Local believes that it has never been completely stopped flowing and will last for next 10 years or so. Water is used for drinking and bathing but not allowed to wash clothes within the spout area. The spout is cleaned during a festival called as 'Yana Punhi' which occurs in Bhadra and during Indra

jatra festival. The outlet was cleared ten years back when it was blocked by the local Maharjan guthi. Sweeper from municipality comes to clean it regularly. The local people also come to clean the spout regularly whenever it is needed.

**7. Kanibahal Hiti:** It lies in ward no. 6 in Kanibahal. It has one spout which is not flowing. Nobody uses the spout anymore. Water flowing from the spout has stopped eight years back. The spout was renovated in 2029 B.S. by the local people and ward office. It worked for sometime then again stopped flowing. It was again maintained in 2060 B.S., flowed for two-three months and then stopped again. The outlet of the spout has also been blocked and now a days, the spouts seems not more than a dumping site. The source is Na Hiti. People claimed that due to construction of buildings along the spout has destroyed the spout. People worship in the spout on Naga Panchami and Sithinakha and clean the spout as well but these activities have been stopped, these days.

**8. Iku Hiti:** It lies in ward no. 7 in Dhobighat. The spout has five spouts and flowing sufficiently. The location of source for this hiti is Jawalakhel. The spout was constructed by the king of Kirtipur during Malla period. Municipality and local people in 2045 B.S renovated the spout jointly. The spout gets its water from Jawalakhel stone spout. More than 500 surrounding households are dependent on the spout for collecting drinking water, bathing and washing clothes. Washing clothes in the spout is prohibited; a pond collecting wastewater flowing from the spout has been constructed for the purpose. The spout has its own management committee to look after the spout. This committee has been running 'water business' since six years i.e. they sell extra water from the spout at the rate of Rs 5 per 100 liter. They earn average of Rs 300 everyday and use the money to pay 2 persons appointed for the business, maintain the outlets and clean the ponds. The committee has also constructed Patti (pavilion with roof), temple and garden. Wasted water from the spout during the night is collected by NWSC in a reservoir and distributed to the local households. People worship in the spout on the festival of Lagankhel Jatra and clean it on Sithi Nakha.

**9. Hiku Hiti:** It lies in ward no. 3 in Dhobighat. The spout has three flowing taps with good quality water and a pond nearby. The source for this spout is unknown. The spout has constructed a shed near the spout, which has been used by women to wash clothes and for bathing. 'Dhobi', laundry is using the spout for washing clothes as their means of income generation. This spout has also locally formed users' committee, which look after the overall management of spouts and collect money from users. The private household pumped extra water from spouts; they pay Rs 300 per month, other users i.e. dhobi pays Rs 200 per month and renters pay Rs 50. The committee is collecting sufficient amount of fund to manage and maintain the spout.

**10. Alko Hiti:** It is situated in Ikhachhen, ward no. 22. The source for this spout is Emu Adv, Alko. This spout is known as one of the highest water discharging hiti in Patan area and one of the most used spout in the valley. The spout was constructed during the reign

of Malla period, on 1415 AD, about 594 years ago. Water from the spout is distributed to 180 households through a distribution channel. People are charged for the water distribution. The money generated is used for the maintenance and running cost of electricity used for collection the water from the hiti to a reservoir. As such, it holds a good example of water management practices which could be replicated by other stone spouts too.

**11. Taapaa Hiti:** It is situated in Naya tole also said as Taapaa hiti, ward no.22. The source for this hiti is Khwayebahi aquifer. The spout has three taps, out of which water flows from only one tap. From past 15 years, the other two tap have dried. There is no any committee established to look after the spout. There is not estimate of exact number of people depending upon the spout. This spout is used in the daily praying and worshipping of deities located inside the hiti premises. During Naag Puja and Shithi Nakha festival, people worship the spout. The spout is allowed for drinking purpose only. The surrounding community are taking care of the stone spout. The date of establishment of this hiti is known but the Lichchhavi time chaitya in the hiti complex describes its establishment not later than Lichchhavi Period (Theophile, E. and Joshi, P. R. 1992).

**12. Washa Hiti:** It is situated in Kumbheswor, Po Tole, ward no.22. The spout has two taps, one is has sufficient water flow and another has very low discharge. There is no any committee to look after the spout. Estimated, more than 100 families use this spout. The water is mainly used for drinking purpose since nearby another stone spout (Siti Hiti) is used for washing purpose. Local people use this hiti to worship and pray daily. Especially they clean and worship to the stone spout during Shithi Nakha festival. Rana people used to use water from this spout in purpose of medicine. The location of the source is Emu Dva, Alko.

**13. Sitha Hiti:** It is situated in Kumbheswor, ward no.22. The spout has one tap, flowing with minimum quantity. Source for this spout is Emu Dva, Alko. The environment surrounding the spout is polluted with waste and garbages. There is no any committee established to look after the spout. More than 50 families use this spout mainly for washing purpose since nearby another stone spout (Wasa Hiti) is used for drinking purpose. The surrounding community are taking care of the stone spout. During Sithi Nakha festival, people worship and clean the spout. During Sithi Nakha festival, people worship and clean the spout. Beside this every morning the spout is worshiped by young people. The source is unknown to people since people never concerned while it never had the problem of drying up.

**14. Amrit Hiti:** It is located in Kumbeshwor, Po tole, ward no. 22. This was constructed during Malla period. Source for this spout is Emu Dva, Alko. This Hiti has two taps. Water is flowing less due to installation of well around. The water dries during the dry season. More than 100 families use this spout for drinking, washing and bathing purpose. This spout was constructed during Malla period. The source for this spout is unknown.

The spout has an idol of lord Bishnu with Laxmi with Garuda. Especially local people clean and worship the stone spout during Shithi Nakha festival.

**15. Konti Hiti:** It is situated in Kumbeshwor, ward no.22. This spout was constructed during Lichchhavi period. Chinkanbahi aquifer is the source for this spout. Out of six taps, three has dried up from this year as dry season has started. This Hiti had never dried before even during the dry season. People told that the ground water is being extracted from around the source area. The water is reserved to a big reservoir tank and distributed to the community people. Only one spout is yielding very less amount of water. Since, there is no any committee established to look after the spout, there is not estimate of exact number of people depending upon the spout. More than 500 families use this spout. The water is mainly used for drinking purpose since nearby another stone spout (Wasa Hiti) is used for washing clothes. The surrounding community are taking care of the stone spout. Kumbeshwor festival observes during the Janai Purnima in premises of this stone spout. Also during Sithi Nakha festival, people worship and clean the spout. Beside this every morning the spout is worshiped by the community people.

**16. Chyasa Hiti:** It is situated in Chyasaal Tole, ward no.11. This spout was constructed on 13th century. The source for this spout is unknown. The spout has 8 taps. More than 1,000 families use this spout; some of the tap becomes dry during the dry season. The water is mainly used for washing and bathing purpose. The surrounding community are taking care of the stone spout. Culturally, people used this spout for daily worship in the morning and celebrate with lighting the oil lamp during Yenya Punhi festival. Also local people clean and worship to this spout during Shithi Nakha festival. Chyasaal Hiti management committee looks after its repair and maintenance.

**17. Naran Hiti:** It is situated in Kwoya Lachi, Chyasaal, ward no.9. The spout has 3 taps. The discharge of these taps is low. The source for this spout is unknown. More than 1,000 families use this spout. The water is used for drinking, washing and bathing purpose. The surrounding community are taking care of the stone spout. Culturally, people used this spout for daily praying and worshiping of deities located inside the premises. Also local people clean and worship to this spout during Shithi Nakha festival. An image of Gajalaxmi (1st century AD) and an inscription of Jayadeva II was found within the premises. It is believed that the stone spout could have been constructed in Lichchhavi period.



**18. Byan Hiti:** It is situated in Chyusal, ward no.9. The spout has 3 taps. The discharge of the spout is low and the source for this spout is unknown. It was constructed during Malla period. More than 300 families use this spout. The water is used for drinking, washing and bathing purpose. The surrounding community are taking care of the stone spout. Especially, local people clean and worship this spout during Shithi Nakha festival and also during their free time. One of spout is installed only about eight years back to tap outlet of Chyusal Hiti. **4.11 Chemical and biological quality of water**

Water quality is directly related to the public health. It is not very possible to find out the chemical content of water supplied through public sources such as stone spouts. The table 4.2 shows the water quality test of 20 stone spouts.

**Table 4.9 Result of spouts' water quality test of LSMC**

S. N.	Name of the spouts	Temp (°C)	pH	NH <sub>3</sub> mg/L	NO <sub>3</sub> mg/L	Cl mg/L	PO <sub>4</sub> mg/L	Fe mg/L	Coliform	Recommendation
<b>WHO Guideline Value</b>			<b>6.5-8.5</b>	<b>1.5</b>	<b>50</b>	<b>100-250</b>	<b>0.5</b>	<b>0.3</b>	<b>negative</b>	
1	Sundhara	20	7.7	3	87.5	67	0.125	0	positive	D.A.T.
2	Sincha Hiti	23	8.1	15	75	48	0.125	0	positive	D.A.T.
3	Naricha Hiti	22	8.1	2.25	100	51	0.2	0	positive	D.A.T.
4	Thapa Hiti	22	8.3	15	87.5	63	0.2	0	positive	D.A.T.
5	Sauga Hiti	2	8.3	2.25	87.5	36	1	0	positive	D.A.T.
6	Manga Hiti	20	8.3	2.25	5	79	0.9	0	positive	D.A.T.
7	Kwonti Hiti	21	8.4	3	5	55	1	0	positive	D.A.T.
8	Washa Hiti	23	8.4	3	10	59	1	0	positive	D.A.T.
9	Alko Hiti	21	8.1	2.25	5	63	1	0	positive	D.A.T.
10	Tapa Hiti	24	8.4	15	10	51	1	0	positive	D.A.T.
11	Chyusal Hiti	21	8.5	2.25	75	24	2.5	0	positive	D.A.T.
12	Naran Hiti	21	8.7	3	5	47	5	0	positive	D.A.T.
13	Amrit Hiti	25	8.5	3	5	51	0.9	0	positive	D.A.T.
14	Subah Hiti	23	8.4	2.25	75	114	5	0	positive	D.A.T.
15	Iku Hiti	24	8.6	15	87.5	32	0.2	0	positive	D.A.T.
16	Hiku	24	8.6	3	62.5	32	0.65	0	positive	D.A.T.
17	Sobha Hiti	24	8.8	7	75	47	0.05	0	positive	D.A.T.
18	Tikhideval Hiti	24	8.3	3	75	47	0.05	0.3	positive	D.A.T.
19	Kal Hiti	23	9	15	10	28	1	5	positive	D.A.T.
20	Tanga Hiti	23	8.8	3	10	32	0.2	0-0.3	positive	D.A.T.

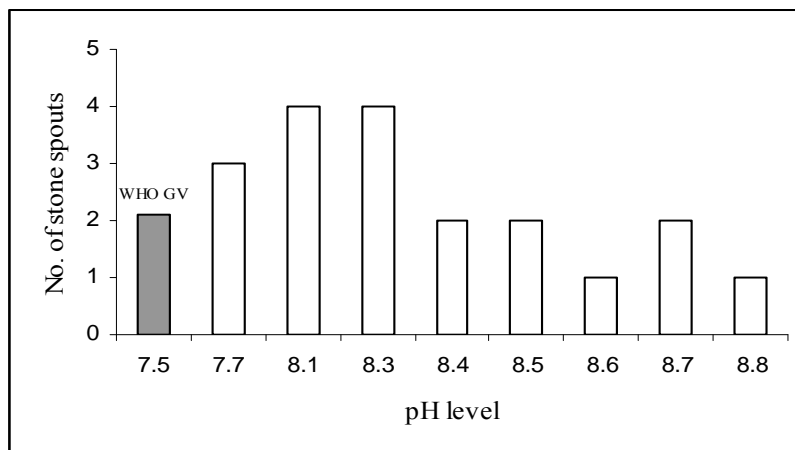
Source: NGOFUWS, 2005

Note: D.A.T - Drink After Treatment

Table 4.3 shows that water from all 20 stone spouts are recommended to drink after treatment. It could also be noted that water from all spouts contain ammonia content which is either due to contamination of domestic wastes in water source or the leachet of chemical fertilizers, since source of the spouts are not protected and lies in the open land. Ammonia content of water could be made stable by chlorination. Similarly, water from 11 spouts has nitrate content higher than the guideline value. Significantly high nitrate presence in drinking water is considered as critical; it may cause death in infants by cyanosis (mithaemoglobinaemia), commonly known as 'blue baby syndrome'. It is seen that all 20 spouts are likely to have positive coliform. Coliform is the commonly-used bacterial indicator of sanitary quality of foods and water. Though test was limited to positive and negative results and it did not show the actual microbial count, the severity of contamination could not be concluded. But, it could be seen that water from all of the spouts are recommended to consume after the treatment.

**pH concentration:** Highly acidic or alkaline water is harmful to health; low pH less than 5.5 causes corrosion effects and high pH above 8.5 decreases chlorinating efficiency of water. The acceptable pH value is 6.5 to 8.5. As shown in table 4.2, water from 6 spouts exceeded the WHO guideline value whereas 14 are within the value. That is to say, 30% of spouts water need treatment before consumption.

Fig. 4.7: Distribution of stone spouts by pH level

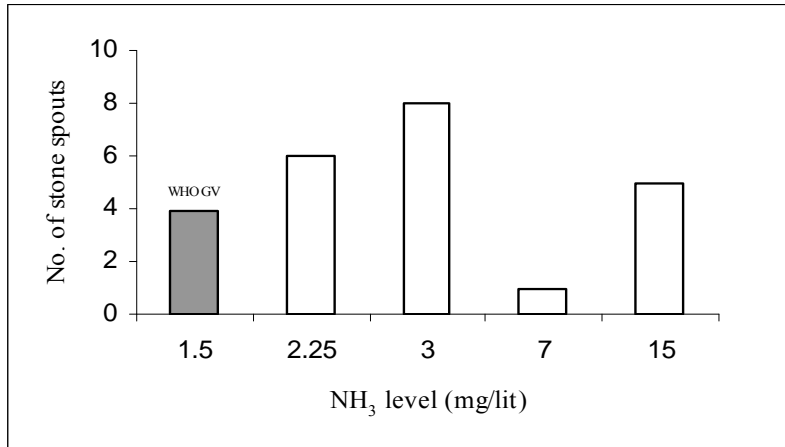


Source: NGOFUWS, 2005

**Ammonia concentration:** Presence of ammonia in water indicates water pollution through human activities and natural decay processes. The presence of ammonia in deep groundwater is due to the natural process of reduction of nitrates and nitrites but sudden fluctuation in ammonia content in water is due to mixing of organic waste. WHO drinking water guideline value for ammonia is 1.5 mg/lit. The table 4.1 shows that water from all spouts contain ammonia content in water which is either due to contamination of domestic wastes in water source or the leachier of chemical fertilizers, since source of the spouts are not protected and lies in the open land. The highest value of ammonia content

has been found in water of Sincha hiti, Thapa Hiti, Tapa Hiti, Iku Hiti and Kal Hiti is 15 mg/lit, which might have significant health impacts. Thus, the source of these spouts should be prevented from contamination from agricultural runoff and sanitary wastes. Ammonia content of water could be made stable by chlorination.

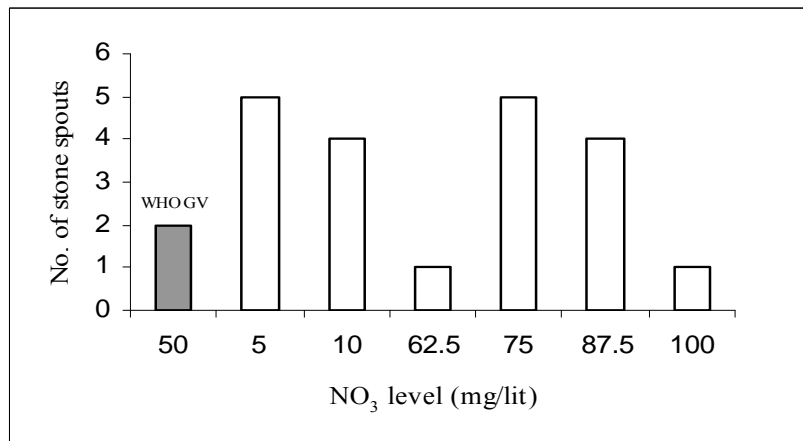
Fig. 4.8: Distribution of stone spouts by ammonia concentration



Source: NGOFUWS, 2005

**Nitrate concentration:** Nitrate content in drinking water indicates that the water is polluted. Significantly high nitrate presence in drinking water is considered as critical; it may cause death in infants by cyanosis (methylhaemoglobinaemia), commonly known as 'blue baby syndrome'. The WHO guideline value for nitrate in drinking water is 50mg/lit. The table 4.1 shows that water from 11 spouts has nitrate content higher than the guideline value. It could be seen that the highest nitrate value i.e. 100 mg/lit is in water of Naricha Hiti.

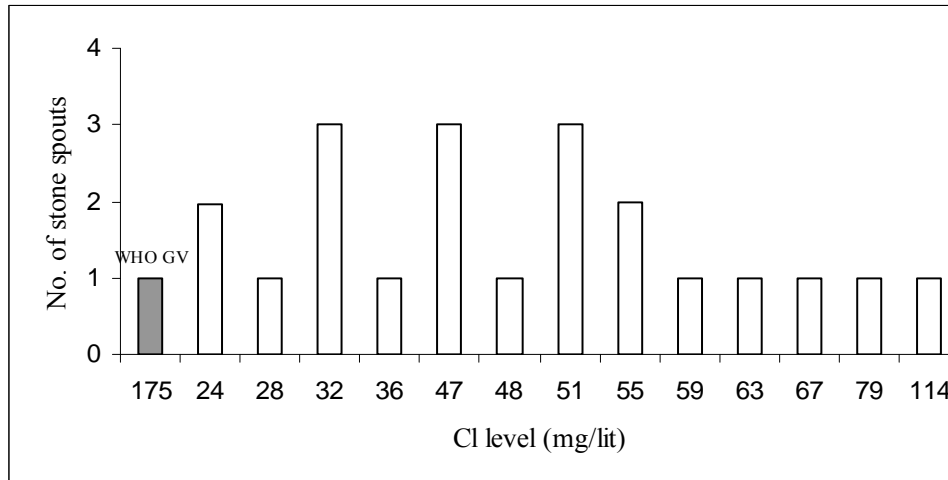
Fig. 4.9: Distribution of stone spouts by nitrate concentration



Source: NGOFUWS, 2005

**Chloride concentration:** The WHO guideline value for chloride is 100 to 250 mg/lit. The results in the table show that chloride concentration of water from all tested spouts is within the guideline value. Excess chloride in portable water causes harmful effects to health. The highest value of chloride content was found in water of Subah Hiti, it has 114-mg/lit chloride concentrations.

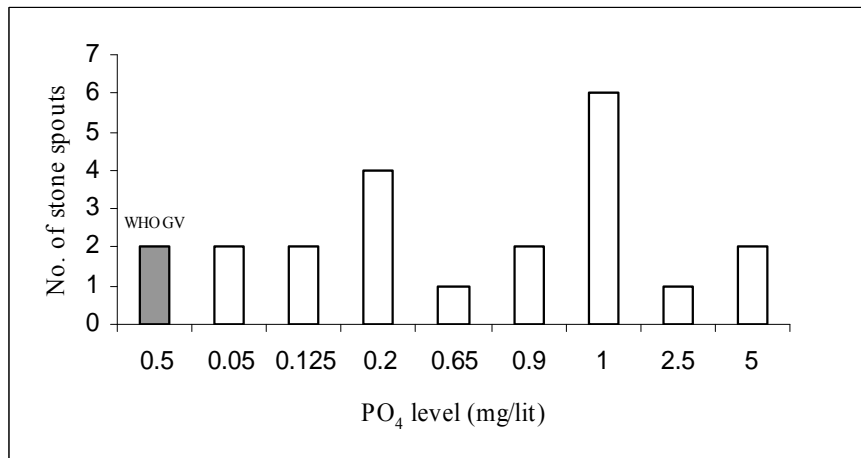
Fig. 4.10: Distribution of stone spouts by chloride concentration



Source: NGOFUWS, 2005

**Phosphate:** Phosphate is an essential element for life as a nutrient and as a key element in the metabolic processes of all living organisms. The WHO guideline does not have phosphate value but European Commission (EC) has given the value as 0.5 mg/lit. According to the table, 12 spouts have high phosphate content; Subah hiti and Naran hiti has phosphate content of 5 mg/lit.

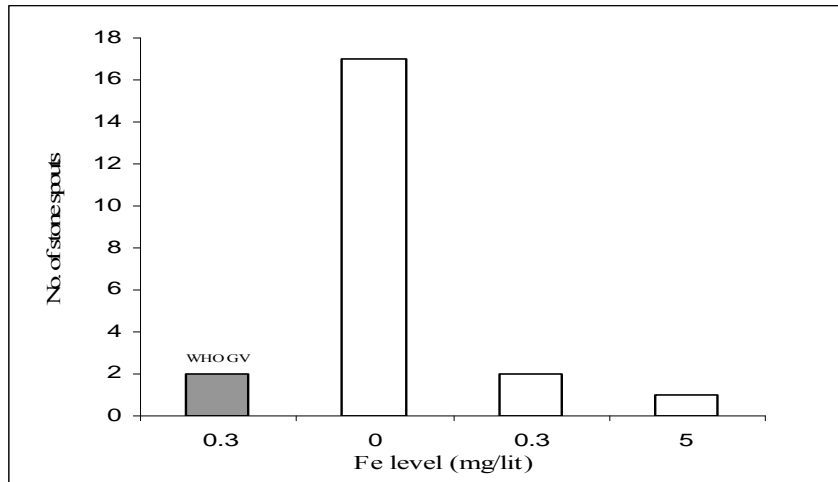
Fig. 4.11: Distribution of stone spouts by phosphate concentration



Source: NGOFUWS, 2005

**Iron concentration:** Iron is present in rocks and soil so all natural source of water contains dissolved iron often in trace amount and sometimes upto 50 mg/lit. Though iron content in water does not have significant health impact, it has aesthetic impact like staining of garments. The WHO guideline value of iron content in drinking water is 0.3 mg/lit. Among the tested 20 spouts, only three has iron and water samples from 17 spouts did not contain any iron.

Fig. 4.12: Distribution of stone spouts by iron content



Source: NGOFUWS, 2005

**Microbiological test:** The WHO guideline value for drinking water quality is that the coliform count must zero per 100 ml of water and according to the Wolf classification, water can be grouped into three categories; excellent, which contains less than 1 or zero coliform, satisfactory, which contains not more than 1 coliform and unsatisfactory that contains more than 1 coliform per 100 ml of water (Ghimire, 1996). According to this, it is seen that all 20 spouts are likely to have positive coliform. Though test was limited to positive and negative results and it did not show the actual microbial count, the severity of contamination could not be concluded. But, it could be seen that water from all of the spouts are recommended to consume prior to treatment.

#### 4.12 Water culture

##### **'Sithi Nakha': Water Conservation Day**

'Sithi Nakha' is an indigenous and traditional festival celebrated within Kathmandu valley at the end of summer season, on 6th day of lunar fortnight in June to welcome rainy season. It was celebrated on 13th of June this year. Before 2-3 days of the celebration of 'Sithi Nakha', houses, courtyard, side streets, allies are cleaned. Besides, there is a tradition of cleaning water sources such as stone spouts, dug wells and ponds. There is a religious belief that the traditional water sources, if not cleaned; there will be scarcity of

water for paddy plantation that starts immediately after this festival. Thus, different sanitation activities are done on this day and before to conserve the water sources. Farmers, especially of Patan City cleans 'Dhalapa' (canal guarding), in turn, to check the leakage and obstacles for the continuous flow. Canal guarding is the system of guarding the canal and its continuous flow for irrigation. There is a strong belief of having the problem of water scarcity if this festival is not celebrated properly. This message has been playing an instrumental role in the traditional Kathmandu valley conserving the water sources and carrying forward the sanitation practices. It has been scientifically proven that the day to celebrate 'Sithi Nakha' is a right time of the year as water level has been lowered in the water sources and it is the time when water scarcity is prevailed extensively.

This festival is said to have been observed to mark the birthday of Kumar, the Hindu deity of war and one of the sons of Lord Shiva, to worship on his birthday as a mark of gratitude for fighting a battle with the demons and helping the gods regain their kingdom. The faithful celebrate Sithi Nakha by visiting Kumar's temple in the southern part of Kathmandu. On this day especially the Newars of the Kathmandu valley prepare a typically Nepali dish made of maas "black lentil" and mugi "kidney beans", kasu "small peas ground", bodi "beans" offer it to Kumar. They take these dishes and enjoy themselves. Next day Kumar (a man portraying Kumar) seated on a peacock beginning from Hanumandhoka Durbar Square in a chariot carried by men in accompaniment with musical instruments played by a nominate party of men along the streets of Kathmandu. Kumar, being a war-lord, his conveyance has been a peacock, a bird of slow and cautious motion, quick change and flights all the qualities needed in an advancing army. The festival also marks the end of Dewaali, a festival when the Nepalese worship their family deities annually. Those families which do not or cannot observe the Deewali for vivid reasons; worship the family deities by way of apologizing and also Kumar on this day.

Generally, livelihood of Kathmandu is based on agriculture and business. Thus, their cultural practice seems to influence by agricultural activities. Farmers are busy in cropping during monsoon season. They do not spend a single minute in other activities. While going to their field they uses stone spouts, wells and spring along the roadside to drink water. They are aware of various water borne diseases caused due to the consumption of unsafe water. In order to be safe from diseases, they clean those water sources in advance during 'Sithi Nakha'. Cleaning of wells and springs from which people, before the supply of filtered drinking water through galvanized pipes and taps, used to drink water is a special feature of the festival.

### ***How it is done: Cleaning of wells and stone spouts***

Water from the well which is to be cleaned is dragged out carefully. Since, wells contain natural gas; it is taken out by dropping and dragging out empty buckets. When it is felt that gas is completely taken out from the well, a lighted candle placed in the bucket is

dropped. If the candle does not turn off quickly then it is known that it is safe to go inside. This is a well established indigenous knowledge among the people to avoid any accident during the festival. Going inside the well is not an easy task. One or two selected strong youths of the community go into the well and collect all wastes and weeds grown inside the well into buckets and pass on to the people above. This work is done rapidly. Women clean the surrounding platform of the well. After cleaning, bleaching powder is kept into the water and it is covered by standing stems of reed plants after performing 'pooja' and is not allowed to use the well for four days. Similarly, surrounding of stone spouts and its outlet canals are also cleaned.

#### **4.13 Discussion for sustainability of traditional water sources**

Sustainability can be viewed simply as "the ability to maintain something undiminished over some time period". It is an ongoing endeavour rather than a final state that implies the persistence of a system through time. There are many other definitions of sustainability; however, they almost always share a common theme; that development of a resource should be regulated such that the characteristics, resilience and integrity of the resource in question are protected and maintained within agreed limits.

Current approaches of water management are highly segregated, focusing on technical improvements and sectoral solutions without sufficient attention to their basic social and sustainability goals. While the world is competing for technology, integrating social values and traditional beliefs has major implications.

Following are three major sustainable elements found out during the study of stone spouts in LSMC.

**Adaptability:** Majority of the population residing in LSMC belongs to Newari caste. It was observed that the homogenous community (in terms of caste) has been managing the spouts wonderfully as they have been adapted to the system since their forefathers' time. Good management practices were observed during the visit to Alko Hiti, Sundhara and Thapa Hiti where major residential are Newars and in Hiku Hiti and Iku Hiti where the most of the community people were 'Dhobis'. In contrast to these Hitis, Sinchahiti conservation committee had been facing difficulty in managing the spouts as most of the water users are from different castes and most of them are renters. Similarly, Pulchowk Hiti, Nag Bahal Hiti and Kanibahal Hiti have completely been out of function, inspite of their good physical structure. It was noticed that the community with these Hitis seems economically well-off and were fulfilling their water demand through NWSC connection and by buying water from tankers when there is water shortage. They remained unaware of the importance of these traditional water sources. These water facilities have become a part of living among the indigenous group of people and among the older generations whereas the migrants and renters do not value them. Awareness activities focused on the importance of such facilities and technology based on indigenous knowledge should be

transferred from older generation to the younger generation in order to make the systems adapting to the external change. User recognition of the benefits of water resource provision through stakeholder participation and gender sensitive approaches is important.

***Management at the local level:*** This was another important sustainable elements understood during the study. Management at the local level signifies possibility to manage the sources using local human and capital resources. Alko Hiti depicts a fine example of management schemes supplying adequate amount of safe drinking water to the local people through local effort. Similarly, water users committee of Iku Hiti has been selling water at the rate of Rs.5 per 100 liter and has collecting sufficient amount of income to develop and maintain the spout and its surrounding. In Hiku Hiti, local people pump up the water from the spouts by fitting individual pipeline; collecting Rs.300 from non-dhobi water users, Rs.200 from dhobis and Rs.50 from the renters. Thus, these successful management practices could be replicated to other stone spouts too, for optimum uses of these traditional water sources to meet daily water demand of the metropolis. In order to make the system sustainable the local authority should make the community based organization/groups, a major stakeholder with devolved power. And local authority can be active in building their capacity.

***Cultural and traditional attachment:*** 'He should not throw urine, excrement or saliva into water nor anything else that is smeared with impurity, nor blood or poisons'. This statement has been taken from Hindu Vedic 4:56. Water is a multifaceted symbol in Hinduism. It is regarded as one of the 'panchtatva' i.e. five primeval elements of the universe along with earth, fire, air and sun. Thus, people have obligatory relationship with any water resources and alarmed to perform any irrelevant activities. Festivals such as 'Sith Nakha', 'Yana Punhi', 'Indra jatra' and performing morning rituals in the natural water sources has been significantly conserving the traditional water sources such as stone spouts and wells. Such drinking water sources become a suitable center for female to share and discuss their problems too, which otherwise would be prevented. Some Baidyas (Ayurvedic homeopathic medical practitioners) also use water from certain spouts to prepare medicines, and there is a strong belief that the water has medicinal qualities used for treating diseases. Incorporating such kind of secondary use of in water facilities would ensure the sustainability of the system. Modern water supply system such as community stand posts has only primary use, i.e. the system used only for collecting water.



## Chapter V

### CONCLUSION AND RECOMMENDATION

Finally, this section tries to conclude the research. It focuses on the main findings and overall analysis and interpretation of the study. Three major elements, effectiveness, cultural acceptability and management and conservation measures of the stone spouts are taken into consideration to conclude the overall findings. The list of recommendations at the end of the report hopes to emphasize future scope of similar kind of research.

#### 5.1 Conclusion

***Effectiveness of stone spouts:*** The effectiveness of any technology can be indicated by its performance. Water from the stone spouts is meant for drinking and other domestic purposes too. Collection of water and bathing are usually allowed at all of the stone spouts; but cleaning utensils and washing clothes may not be allowed. However, the use of water is not limited to household purposes only; the spout waters are considered pure and holy and are used daily in religious functions, rites and rituals in temples and shrines.

There are altogether 56 stone spouts in LSMC; of which only 44 are in good condition. Stone spouts, traditionally build to supply water to small population in a localized area, could take a much greater importance as NWSC is unable to supply required amount of water to all of the population of Nepal due to high population growth and unplanned urbanization. It has been found that stone spouts benefit between 150 and 250 persons per spout in Kathmandu, and between 300 and 400 persons per spout in Patan. Extra water from these spouts is carried by tankers and distributed in areas of water scarcity. The average total discharge of existing spouts of LSMC is 4,646,633.33 litres per day, a volume sufficient to theoretically supply some 46,466 people, i.e. 30% of total population of LSMC (assuming a per capita demand of 100 litres per day). Thus, the conservation and revitalization of these spouts could contribute to a reduction in the acute water shortage in the Metropolis.

***Cultural Acceptability:*** The traditional stone spouts are believed to be a sacred heritage and a system for their operation and maintenance exists among the local people of LSMC culturally, hence this could be major sustainable element for its conservation. It could be recommended to incorporate such traditional societal beliefs while constructing any such community water supply systems. It could be noticed that though the water quality tests of 20 selected stone spouts was beyond recommended the value of drinkable WHO guideline, people has not hesitated to use water for drinking purpose; reasons might be either they are unaware of the fact or they considered these sources sacred. Cautious chlorination of water from stone spouts could be recommended before consumption.

**Management and Conservation measures:** The protection and revitalization of stone spouts may involve the relocation of many buildings constructed near the spouts that have encroached to the public property. These building not only contributed to the disturbance of the natural aquifers and supply lines to the spouts but also contaminated the sources. One such example is Pulchowk Hiti, which has been stopped flowing due to construction of building near the spout. It is also reported that all of the tested spouts are contaminated in some way. Management scheme adopted by some spouts like Alko Hiti, Iku Hiti and Hiku Hiti could be replicated in other spouts too, for its sustainable use.

## 5.2 Challenges in the sustainability of traditional water sources

The study has shown that there are different challenges in the sustainability of the traditional water sources. The challenges are as follows:

- 1. The social challenges:** There is in-migration and out-migration taking place. Family separation due to limited space or due to family conflict, core people are migration out. Whereas people from different part of the country with variety of cultural background are migrating in. This bring differ in understanding of the stone spouts and so conflict takes place resulting the poor management of the stone spouts. Maintenance of the stone spouts to keep it running can be done but to meet the demand of the growing population is one of the biggest challenges.
- 2. The management challenges:** The growing urbanization is a biggest threat for destroying the old socio-economic base, and thus the social practice. The single-most cause of destruction of traditional management system is the erroneous policy of the government to centralised management of the *guthi* system under Nepal Guthi Corporation. This centralised system coupled with imprudent policy of replacing trust land by cash, has destroyed the *guthi* and subsequently the whole management system that could survive more than a millennium. This opportunity of breaking down the *guthies* not only raised greed of people to grabbing the trust land, but also evoked them to hide other important information, knowledge and wisdom which otherwise would have been shared with the new generation. (UN-HABITAT, 2007). Thus, the management of the stone spouts much be in the ownership of respective community.
- 3. The legal challenges:** The Interim Constitution of Nepal (2007) has categorically supported the right to conserve and promote civilization, culture, heritage including others<sup>1</sup>. The more than 1500 years old water supply system undoubtedly lies under the scope of this constitutional provision. There is a lack of policy for ground water use. Due to rapid urban growth and insufficient water supply from

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<sup>1</sup> Interim Constitution of Nepal 2063 (including 2064 amendments) (in Nepali) under Section 3.17.3 Civil right provision states that all the communities residing in Nepal would have right to protect and conserve their language, script, culture, civilization and heritage.

the government, people started extracting water from the ground through dug wells and hand pumps. However, these cases do not answer the issues of extracting ground water by the houses at the source or in the flow path for their household purposes. Does the land ownership also gives right to ground water beneath it or not? Does the land title allows constructing house and infrastructure that damage or restricts the natural flow of ground water? If proven that the construction of infrastructures in recent past, be it private or public; that is damaging/hampering the water system, can it be corrected or removed by the person or institution doing so? To address these issues, a clear legislation addressing ground water issues including drinking purpose is of dare need. However while preparing such legal tools; the social organisations should use their political strengths to safeguard these historical and public systems. Two major provisions may be used for such purposes for the time being. That are the provision of Water Resource Act (1992) that declares the ownership of water found within the Kingdom of Nepal is vested in the state (WAN, 2005). The second provision of the same act that helps to protect the system is the priority of water use is given to drinking water and domestic use (WAN, 2005). The third basis, in case of traditional *hities*, can be drawn from the Ancient Monument Protection Act (1956) where these centuries old system should be registered as national monument and heritage. Moreover, Environment Protection Act (1996) also provides room for declaring *hiti* systems as National Heritage<sup>2</sup>.

- 4. The technical challenges:** One of the first questions raised in every discourse of traditional *hities* is the ‘proof’ of aquifer that is serving particular *hiti* or groups of *hities*. These issues are raised with several intentions, sometimes to find excuse for encroaching the aquifer and the path of ground water flow. And, there are also good reasons to explore these aspects as to conserve the area both to recharge the water and control the activities affecting quantity as well as quality of water. UDLE, in its studies of Patan Conservation and Development Programme, conducted several studies on various aspects of ground water in Patan related to *hities* in 1992/93 (Joshi, P. R. 1993). These studies are a good basis for the further exploration of the issues. A clear demarcation of all the aquifers large and small is crucial for the conservation of traditional water works. (UN-HABITAT, 2007)

Haphazard construction of building is damaging and disturbing the underground water channels through where water from ponds and aquifers are supplied to the stone spouts. Therefore, mapping the underground water channels linking the aquifers to *hities*, and conserving the outlets are the preconditions for scientific and sustainable management of traditional *hities*.

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<sup>2</sup> EPA 1996 Clause 9 has provision to declare national heritage. By enlisting the site and publishing in the gazette National heritage may be declared by the government.

### **5.3 Prospect**

It can be seen a good management practice of traditional stone spouts in the heterogeneous community than the homogeneous community since they holds more ownership and understanding of the traditional and religious values. Likewise, to have a good management practice the management of these traditional stone spouts should be given to the local community rather than the government. By having a management committee for the stone spouts, indeed successful practice could be seen like we can take the example of the Alko hiti management committee. Beside this, the other important elements is the government's policy for the ground water use, which should be brought as soon as possible, and the control over the haphazard urbanisation which is the main cause of destroying the water channels and ponds/aquifers that supply the water to these stone spouts.

### **5.4 Recommendations**

#### **5.4.1 Recommendations for the management**

The study has shown that water sample from all the 20 stone spouts are contaminated with excess amount of ammonia and water samples from 11 spouts contain excess nitrates. Also the drying up of many spouts has been occurred due to decreasing underground water table and the stone spouts having community based management committee has been performing a wonderful work. Based on these findings following recommendations has been made for the management.

- Specific pollution control mechanism to prevent mixing up of sewer in the water sources at the community as well as municipality level is to be constructed.
- Ground water recharge technologies such as rain water harvesting and pond creation should be promoted
- Separate storm water and sewerage system in order to exit surface run-off into the ponds should be created.
- The management of community water facilities should be handed over to the community for its sustainable uses

#### **5.4.2 Recommendations for further study**

During the study detail information on relationship between recharge pond and discharge in stone spouts, hydro-geological flow of water in the spouts and detail chemical parameters of the water of stone spouts was insufficient. Thus, following recommendations has been made for further study.

- Study on the linkages between recharge ponds and discharge in stone spouts is recommended.
- A study on hydro-geological flow of water from the source to stone spouts is recommended.
- A study on effectiveness of homogeneous community Vs heterogeneous community to manage community water sources is suggested.
- A study on detail chemical parameters of water of stone spouts is recommended.

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# **Annex**









**Annex I**




**List of Pictures**




SN	Name of the Stone Spout	Picture
1.	Pulchowk Hiti	
2.	Chha Bahal Hiti	
3.	Nagbahal Hiti	

SN	Name of the Stone Spout	Picture
4.	Sundhara Hiti	 <p>A photograph of the Sundhara Hiti stone spout. It is a large, ornate structure made of reddish-brown stone with multiple tiers and decorative carvings. The spout is set in a paved area, and there are people and buildings visible in the background.</p>
5.	Sincha Hiti	 <p>A photograph of the Sincha Hiti stone spout. It is a simple, rectangular stone structure with a central spout. The structure is surrounded by a brick wall and a paved area. There are some plants and a fence in the background.</p>
6.	Thapa Hiti	 <p>A photograph of the Thapa Hiti stone spout. It is a large, rectangular stone structure with a central spout. The structure is surrounded by a brick wall and a paved area. Several people are gathered around the spout, and there are some plants and a fence in the background.</p>

SN	Name of the Stone Spout	Picture
7.	Tyagal Hiti	
8.	Kanibahal Hiti	
9.	Iku Hiti	

SN	Name of the Stone Spout	Picture
10.	Hiku Hiti	
11.	Alko Hiti	
12.	Taapaa Hiti	

SN	Name of the Stone Spout	Picture
13.	Sitha Hiti	
14.	Wasa Hiti	
15.	Amrit Hiti	

SN	Name of the Stone Spout	Picture
16.	Konti Hiti	
17.	Naran Hiti	
18.	Byan Hiti	

## **Annex II List of Study Questionnaires**

- What are the existing traditional water sources of the community?
- What is the present condition of these sources?
- Who uses the sources the most?
- What was its condition in the old days?
- What is the historical background of the sources?
- Do the people perform any religious, cultural or traditional activities related with the water sources?
- If they, what are those activities?
- What are significant role of the water sources while performing their religious, cultural or traditional activities?
- Who perform the activities, older generations or younger generations?
- Are younger generations are fond of performing such activities or they neglect them?
- Is the water quality and discharge of the traditional sources is similar as it used to be in the old days?
- Do they think that these are important to be conserved?
- Have any organizations are involved in conserving the sources? In what way they are showing their interest to protect the sources?

## Annex III

### An interview with Bhaju Ratna Shakya

Following is an interview conducted with Bhaju Ratna Shakya, a committee member of 'Alko Hiti Conservation and Water Users Committee'. As known from above, Alko Hiti has been managed and used in an example, it is thought to highlight so that its practices can be replicated. An open-ended questionnaire set was developed prior to the interview.

*1. How long have you been using water from Alko Hiti?*

Since my grandfather's grandfather time. Alko Hiti has been constructed by Tuhudev Bajracharya in 535 N.S. and we never knew it being out of function. It has been flowing ever since with sufficient amount of water.

*2. What difference have you found in the spout in terms of its discharge and quality, now and then? Where its waste water does flow?*

As I have already told, there is no such record of spouts being dried up. The water quality is very good and people once, habituated to drink water from Alko Hiti, found water from other sources tasteless. There is a bone mill nearby. In 2057 B.S. water from the spouts flowed with blood; this might be due to the underground contamination of blood from the mill. Locals pressurized to discontinue the mill and now a day, it only collects the clean bone. It has a discharge of about 0.5 millions litres per day, which is a significant amount of water to suffice daily water demand of the local people.

Wastewater from the spout flows through private paddy fields and ultimately to the Bagmati River.

*3. Is there any kind of legend behind the spout?*

There is a very interesting story behind the construction of Alko Hiti. Once a female Naag (snake god) had an eye problem and Tuhudev Bajracharya, a famous Tantric was able to cure her. Her husband, male Naag was very pleased with the Tantric and gave him five very fine stones. Tuhudev kept it secretly in a clay pot and locked it in his storeroom. His wife didn't know about these stones. Once she saw the pot in the room and was curious to found out its content. She entered the room, one day, when her husband was out and looked in the pot. She found nothing more than just five stones in the pot. She found these stones useless to keep and threw it out of the window. In the mean time, Tuhudev came to know this and went outside to look for the stones. To his surprise, he found water bubbling out in every place where the five stones had landed. Then, he used his Tantric power to construct five spouts in five places of stones. Today, those spouts are known as Alko Hiti.



*4. Is there any religious activity performed in the spout?*

Local people along with the committee members clean up the spouts to celebrate Sithi Nakha. The descendents of Bajracharya family regularly worship the spout and held a 'puja' ceremony annually. Exhibition of sculptures made by local people is conducted during 'Indrajatra' every year in the spout; on that day nobody uses water from the spout. Besides all these, water from the spout is considered as sacred and so used in daily morning rituals.

We used to see snakes wondering in the spouts 15/20 years back but now-a-days, due to extensive number of water users and use of soaps and shampoos, snakes are rarely seen.

*5. Where is the source of water?*

The spout has a natural underground source which lies to the south of Alko Hiti. The land where water source lies has a private owner and any construction activity on the land would affect the water flow in the spouts. Debate between water users around Alko Hiti and the owner has been going on since the time it was constructed. The community wants to buy the land but it is unable to afford Rs 1 million. We are looking for support from experts and the government to secure the source in order to conserve the spouts, which is serving 300 households around the spout.

*6. When was the committee formed and what is its objective?*

The committee was formed in 2003 A.D. with a name ' Alko Hiti Samrakchhyan Tatha Khane Pani Upabhokta Samiti' (Alko Hiti Conservation and Drinking water Users Committee). Its major duty is to provide safe and adequate potable water to the users around the spout.

*7. How this new and innovative idea of supplying water at household level came up?*

There are altogether 150 households in Ikhachhen and all these have private NWSC connection, which is rarely supplied with water. There used to be severe water scarcity in this community. So, it was thought to form a local water users committee and supply extra water from Alko Hiti at the household level. The community people supported this idea and showed commitment to help financially too.

*8. How is the water supply network managed?*

The committee has constructed a three-storied tower near the spout to support the storage tank. The capacity of the tank is 10,000 litres. Every households of the community contributed Rs 2,000 to build the tower. Water is pumped to the tank and is supplied to the houses. There is main pipeline fitted at every consecutive 5/6 houses and individual houses has connected their pipe to this junction. Total of 180 households including 30 from outside the community has connected to this distribution network. Water is supplied to each cluster of 35 houses at a time for 45 minutes every evening from 6 p.m. to 11 p.m.

*9. How is the fund collected?*

The total cost of the project is Rs. 4,50,000; of which few has been contributed by community people and other in loan that still needs to be paid. We have been collecting the water tariff in two ways; water users of Ikhachhen pay Rs.100 per month and users outside the community pay Rs.125 as they does not need to involve in maintenance. The collected money is utilized to pay the salary of 4 staffs appointed to look after and manage the supply system and to maintain the supply.

*10. What about the quality control of water?*

The committee is very much conscious about the quality of the water supply. We regularly maintain the spouts and clean them every month; we test the water quality every two years. So far there has not been any complain regarding water quality.

*11. Is there been any organization involved in conserving the source?*

A NGO named as NGO Forum for Urban Water and Sanitation had shown interest to support us but our committee is locally formed and not registered so they could not helped us. They told us to register as a NGO but we thought that it is so soon to register. And we failed to get the support.

*12. Any future plans.....*

Our major most priority is to manage the fund for buying the land where the source lies and we are seeking potential organizations to support us. Beside this, our plan is to extend our supply network to serve 500 households in the locality; for this we have plan to construct underground reservoir of 150,000 litres capacity. We are thinking of to reserve water wasted during the night and also to sell water to the tanker in order to gather enough fund. NGO Forum for Urban Water and Sanitation has planned to support us to make software for detecting leakage in the distribution network, in near future.