Impacts of Urbanization in Khairenitar Small Town Water Supply and Sanitation Sector Project

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Disclaimer

The findings, interpretations and conclusions expressed herein are those of author (s) and do not necessarily reflect the views of the institutions

Foreword

This research was part of Water and Climate Resilience Program (WACREP) activity of Jalsrot Vikas Sanstha (JVS)/ GWP Nepal. JVS/GWP Nepal highly appreciates the contribution of the study team Ms. Monica Maharjan, Mr. Prakash Gaudel and Dr. Vijaya Shrestha. (JVS)/ GWP Nepal also acknowledges the contribution from Mr. Tejendra G.C and Ms. Neha Basnet during the preparation of this publication

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Abbreviations

B.S.	Bikram Sambat
CBS	Central Bureau of Statistics
FGD	Focus Group Discussion
HH	Household
KII	Key Informant Interview
KSTWSSSP	Khairenitar Small Town Water Supply and Sanitation Sector Project
KSTWUSC	Khairenitar Small Town Water Users and Sanitation Committee
OHT	Overhead Tank
Rs.	Rupees
STWSSSP	Small Town Water Supply and Sanitation Sector Project
VDC	Village Development Committee

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Executive Summary

Urbanization is a noticeable phenomenon in the developing parts of the world, which is also evident in different parts of Nepal. The rates of urbanisation in Nepal are among the highest in South Asia. The urbanisation growth occurring in Nepal is not only rapid but also haphazard. The infrastructural development activities being carried out lack synchronisation with the population growth, environment balance and sustainable planning due to which the possibility of economic activities are outweighed by socio-economic and environmental challenges, associated with the quality of land, water and air. In regards to these challenges, water use, its increasing demand, scarcity and deterioration in quality is the one that affects the fundamental right of living and economic development. Khairenitar, a market centre in Shuklagandaki Municipality in Tanahu District, a rapidly growing city was chosen for this study which aimed to understand the urban development from the perspective of drinking water facilities & water resource management.

The objectives to carry out the study include assessing the perception of water users on functionality of water service (quantity, accessibility, reliability and quality) and identify the management challenges for water supply. To carry out the study both primary and secondary data were used. Focused group discussion, Key-informant interview and Household survey was carried out for the primary data collection whereas, literature review of different publications was done for secondary data collection. From the study itv was found that Khairenitar STWSSSP has been serving 1342 private taps and two (2) public taps currently but the application for the new tap is increasing day by day .With the incremental volume of water consumption, there is a progressive rate of tariff. The service level functionality assessment of the Khairenitar STWSSP, revealed the dissatisfaction of consumers with regards to both quantity and quality of water. The different management issues of Khairenitar STWSSP, includes population growth, source depletion, insufficient staff, lack of treatment facilities, lack of source conservation and rehabilitation initiatives etc.

The recommendation generated from the findings of the study includes, provision of rehabilitation and source conservation for the continuous supply of water, ensuring the quality as well as the quantity of the water supply to the consumers. Need for the coordination and planning between water service providers and urban planners, provision of adequate operators for the timely maintenance of the system in case of the breakage of the system to provide efficient, reliable and quality water.

CHAPTER I

INTRODUCTION

1.1 Background

Urbanization is rapidly occurring phenomenon in developing part of the world. Many studies have predicted that around 70% of the world's population will be residing in urban areas by mid-century (IPCC 2014; UN 2014; OECD 2010). The rates of urbanization in Nepal are among the highest in South Asia (Choe & Pradhan 2010). Urban growth in Nepal is not only rapid but also haphazard. Planning and provision of infrastructure and facilities has been out of sync with the growth in the country (ibid). Although urbanization brings more economic activities, these are outweighed by socio-economic and environmental challenges, often associated with the quality of land, water and air. Water is fundamental to living and economic development. The fact that it is a finite resource with multiple usages makes it prone to mismanagement. Moreover, the seasonal variation in the availability of water in Nepal worsens the sectoral competition. Over-extraction of water from sources to supply the cities and poor management of wastewater is a common scenario in many parts of urban Nepal (WAN 2008).

With the increasing trend of rural to urban migration, small towns are rapidly emerging in Nepal. As pointed out by Adank (2013), small towns are grey area between rural and urban, where provision of water service lies somewhere between community-managed rural water supplies and supply managed by large urban utilities. He also states that small towns are very likely to grow in number and their importance will also increase as the population swells leading to rural to urban migration. Existing small town water supply schemes are stressed by rapid pace of urbanization and are often in need of rehabilitation and service extension to ensure water supply services to growing population. It is stated in Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016 – 2030) that the water supply service levels are articulated through system and institutional performance (MoWSS 2016). In this premises, this paper aimed to understand the impacts of urban development in Khairenitar Small Town Water Supply and Sanitation Sector

Project area on service level functionality (Quantity, Accessibility and Quality of water supply) and institutional performance (Reliability). It has analyzed the impacts of urbanization on water resources in terms of management. By highlighting the concerns about effects of urbanization, the study has intended to promote awareness on the efficient uses of water, better planning and management practices and increased user ownership of population and environment linkages and other associated issues. The study is expected to draw attention of the policy-makers to focus water sector development based on growing issues of urbanization and climate change.

1.2 Objective of the study

The major objective of the study is to explore the changes brought about by urbanization and assess its impacts on Khairentar STWSSSP in Suklagandaki municipality. The specific objectives are as follows:

- To assess the perception of water users on functionality of water service (quantity, accessibility, reliability and quality) in an urbanizing context
- To identify the management challenges for water supply

CHAPTER II

METHODOLOGY

2.1 Data Collection

The study has utilized both primary and secondary data. For baseline information about the project related facts and figures, secondary sources were used, which also substantiate the primary data. Primary data were collected using the research tools such as Key Informant Interview (KII), Focus Group Discussion (FGD) and Survey.

Key Informant Interview: Relevant information have been collected from key informants that included Chief Officer of KSTWSSSP and Ward Chief of Suklagandaki municipality.

Focus Group Discussion: A focus group discussion was also held with the executive members of Khairenitar Small Town Drinking Water Users' and Sanitation Organization.

Household Survey: Furthermore, a household survey was conducted in ward no. 6 and 7 of the municipalities that included old consumers, new consumers as well as prospective consumers. The total number of households of ward 10 and 11 selected for Third Small Towns Water Supply and Sanitation Project – Khairenitar was 1,434 in 2014 (MoUD 2016), which is now converted to ward 6 and 7. The data on number of households and population of ward 6 and 7 could not be obtained as the census is still to be carried out after the changes. Hence, 5% of population data of 2014 has been considered and a sample of 71 households were randomly selected in the aforementioned wards in order to assess the current situation of water quality, quantity and service delivery in the face of urbanization.

2.2 Framework for analysis

The service level functionality and institutional performance have been analyzed through i) Users' perception and experience and ii) Management. These two pints of view have been used because understanding the stories of both service provider and service users is important to grasp the whole picture.

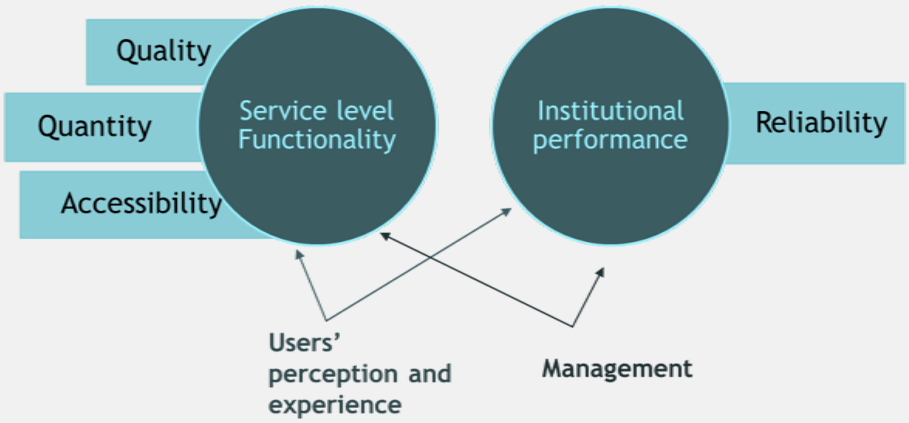

Figure 2.1: Framework for analysis

2.3 Case for the Study

2.3.1 Khairenitar Small Towns Water Supply and Sanitation Sector Project (KSTWSSSP)

Khairenitar is a growing town and major economic hub in Suklagandaki municipality. Prithvi Highway, which opened in around 2025 (B.S.) transects Khairenitar bazaar, facilitated the road connectivity with Pokhara, the tourist center and Kathmandu, the capital city leading to increased economic activities and opportunities. People started dwelling in Khairenitar more than 6 decades ago. With the increase in settlements, Okhale Drinking Water Project was started with the financial assistance from District Panchayat, Tanahu in 2022. Later in 2051, 62 private and 106 public were distributed by tapping 1.5 lps water from Kewurang River with the financial and technical assistance of district drinking water supply office. A storage tank with a capacity of 100 cubic litres was constructed then. The Asian Development Bank has been assisting Government of Nepal in developing Small Towns Water Supply and Sanitation Sector Project (STWSSSP) since 2001, which has played an important role in providing improved water supply and sanitation services for towns and emerging urban areas of Nepal. Khairenitar STWSSSP scheme was one of the 29 subprojects constructed during ADB's first phase of the STWSSSP (A.D. 2001-2009) which became fully functional in A.D. 2005. Khairenitar was selected for the Third Phase of STWSSSP under "Enhance Functionality in Small Towns Water Supply and Sanitation Sector Project" in order to rehabilitate the scheme. In the first phase, ADB

covered 50% cost and users covered 20% with remaining 30% as a loan component but in third phase, ADB is taking care of 70% cost while the users are supposed to manage rest of the cost for rehabilitation.

2.3.2 Urbanization in Suklagandaki municipality

Increase in the number of urban areas (municipalities), expansion of existing areas and steady increase in urban population are, inter alia, the characteristics of urban growth in Nepal. The government of Nepal has been declaring many village development committees (VDCs) as municipalities as a response to growing population and emerging towns. Until 2014, Nepal had only 58 municipalities. In 2014/15, significant numbers of VDCs were integrated into the neighboring VDCs and/or municipalities resulting into expanded territory. Since the 1950s urban population increased from 0.238 million to 4.52 million while the number of designated urban places (municipalities) increased from 10 to 217 in 2015 (Subedi 2014). KSTWSSSP was also affected by this change. Accordingly three village development committees, Dhorphirdi, Dulegaunda and Khairenitar were merged to form Shuklagandaki municipality on 18 May 2015. Initially, the scheme was intended to serve 808 households in wards no. 8 and 9 of Khairenitar VDC. But now, it has to serve ward no. 6 and plains of ward no. 7 of Suklagandaki municipality which cover larger area and more households than before. The change in the number of households as a result of the merger is reflected by the following table:

Table 2.1: Number of households in Suklagandaki municipality

VDC	Owned	Rented	Total HH
Dhorphirdi	2738	216	3005
Dulegaunda	2618	1239	3992
Khairenitar	2067	558	**2679**
	7423	2013	**9676**

Source: CBS, 2014

Migration to Khairenitar is high due to the fact that Kaski, the most urbanized district (Subedi 2014) and tourist centre and construction of highway linking Kathmandu is only 27km away. Gaudel (2010) too has documented that migration from adjoining hills to Khairenitar started after the construction of Prithvi Highway that resulted in significant increase in the population.

CHAPTER III

FINDING AND DISCUSSION

3.1 An overview of the system

3.1.1 Source: Initially, Khairenitar STWSSSP was developed as a surface water system (MoUD 2016). With the growing demand for water and insufficient water at the sources, the system had to opt for additional sources too. Currently, five sources including one bore hole are feeding water into the system (Table 3.1). The water extraction through borehole drilling started last year in 2073. The deep boring was done at a level of 130m below ground. According to Mr. Shreeram Subedi, the Chief Officer of KSTWSSSP, the water level was at 34m in the beginning but in a span of just a year, the level has gone down to 44m (interview in person on 12 Sep 2017). The daily water production in the system is 992 units or 992,000 litres of water which are being supplied two times a day, in the morning and evening for three hours each. During lean season (March, April and May), the supply is limited to one time supply for three hours.

Table 3.1: Water Sources of KSTWSSSP

S.N.	Name of the source	Flow rate (litres per second)	
		Initial	Current
1	Jamdi spring	6 lps	5 lps
2	Kewurang spring	2 lps	1.5 lps
3	Bhungbhunge	2 lps	2 lps
4	Deep Boring (Groundwater)	-	7 lps
5	Jamdi River	-	10 lps

3.1.2 Water reservoir: There are four underground water storage tanks and one overhead tank (OHT) is recently constructed. The capacity of the tanks is shown in the Table 2.

Table 3.2: Water storage facility of KSTWSSSP

S.N.	Source/Locality of tanks	Type	Capacity (cubic litres)
1	Jamdi	Underground	150
2	Kewurang	Underground	100
3	Bhungbhunge	Underground	150

4		Sub tank (Underground)	14
5	Near deep boring area	Overhead Tank	450

3.1.3 Treatment facilities: KSTWSSSP is facilitated with a plain sedimentation filter, two pressure sand filters (PSF), two horizontal-flow roughing filters (HRF), a slow-sand filter (SSF) and two chlorination units. Before supplying water to the households, chlorination is done as a chemical treatment. The underground water extracted through deep boring contains iron and hence, aeration was being practiced to oxidize iron by allowing the water to trickle through perforated trays containing small stones. Recently, a new pressure filter has been added in the treatment facility.

3.1.4 Number of connection and pipeline: Altogether, the system is serving 1342 private taps and two (2) public taps currently. There are more than 500 new applications for the service and the count goes on every day. The length of the distribution pipeline is 28.3 km (26 km initially and 2.3 km during rehabilitation) and that of transmission pipeline is 20.5 km (14 km initially and 6.5 km during rehabilitation) making the total length of pipeline 48.8 km.

3.1.5 Water tariff: A differential tariff structure has been set for Khairenitar STWSSSP. The old water supply scheme in Khairenitar used to have a regressive rate of water tariff which means those consuming less volume of water were required to pay more than the ones consuming more volume of water (Gaudel, 2010). But now, there is a progressive rate wherein tariff blocks are set on the basis of incremental volume of water consumption. This change has favored poorer households (Gaudel 2010). This has also been regulating the water consuming behavior of the people. The users of Khairenitar STWSSSP have to pay minimum monthly tariff of Rs 120 for maximum of 10m^3 of water. The tariff blocks have been revised with the growing users and water demand reflected in Table 3.3 and 3.4.

Table 3.3: Monthly tariff structure

S.N.	Units*	Amount (NRs)
1	0 – 10	65
2	11 -20	8 per unit
3	21 – 30	9 per unit
4	Above 31	10 per unit

*1 unit = $1m^3$ = 1000 liters, Source (Gaudel 2010)

Table 3.4: Revised monthly tariff structure

S.N.	Units	Amount (NRs)
1	0 - 10	120
2	11 -15	15 per unit
3	21 - 25	18 per unit
4	Above 25	25 per unit

Source: KSTWSSSP Office, 2017

3.1.6 System Management Team: Altogether there are 10 staffs employed for managing the system which is serving 1,344 households and likely to serve more in near future. The number of technical staff is just four for the whole system indicating the difficulties faced by the consumers during technical malfunctions. No full time engineer is in place. The system requires more technical staffs not only for the physical expansion of the system but also to carry out necessary maintenance works as required. During the recent visit to the system, the Water Users and Sanitation committee seemed to be geared for recruiting an engineer.

Table 3.4: Number and types of staff

S.N.	**Staff type**	**Designation**	**Number**
1	Administrative	Chief Officer	1
2	Administrative	Office Assistant	1
3	Technical	Meter Reader	1
4	Technical	Plumber	3
5	Technical	Engineer	0
6	Non-technical	Guard/Keeper (Source)	2
7	Non-technical	Guard/Keeper (Tanks)	2
Total			10

Source: KSTWSSSP Office, 2017

Khairenitar Small Town Drinking Water Users and Sanitation Organization was formed in 2003 with 9 functionaries including women (33%) in Khairenitar Small Town Water Users

and Sanitation Committee (KSTWUSC) or the main committee. There are five sub-committees, namely Advisory, Accounting, Maintenance, Investigation and Monitoring Committees each with 7 members except Accounting Committee which has 5 members. Table 3.5 shows the current functionaries of the main committee.

Table 3.5: Number and designation of the functionaries of KSTWUSC

Designation	**Number**
President	1
Vice-President	1
Secretary	1
Joint Secretary	1
Treasurer	1
Member	4
Total	9

3.2 Socio-economic status of the users

The social characteristics are important indicators of water-use behavior of people at household level. The household survey conducted in Suklagandaki municipality tried to grasp some characteristics of users. The respondents comprise 59% female and 41% male. Most of the respondents were between the ages of 31 to 40. Although, all respondents were literate, only 1% (7 households) of the respondents have the university degree while 49% have acquired primary level education. Most respondents (42%) still practice agriculture as major occupation followed by business (28%) while 14% of the respondents generate income through renting their houses. This is a very important piece of information about urbanization in the area. The renting population is an indicator of migration. Migration has resulted in growing number of people consuming water. On top of that, the water consuming pattern is also changing owing to changed life style and housing pattern, i.e., toilets inside the house (flush system) unlike the rural toilets which are normally built outside the house, (one toilet/household) with pour flush system. This is a

normal phenomenon in an urban area where the economic activities are more than in rural setting. Hence, with urbanization, changed life style and increase in incomes, per capita water demand also rises.

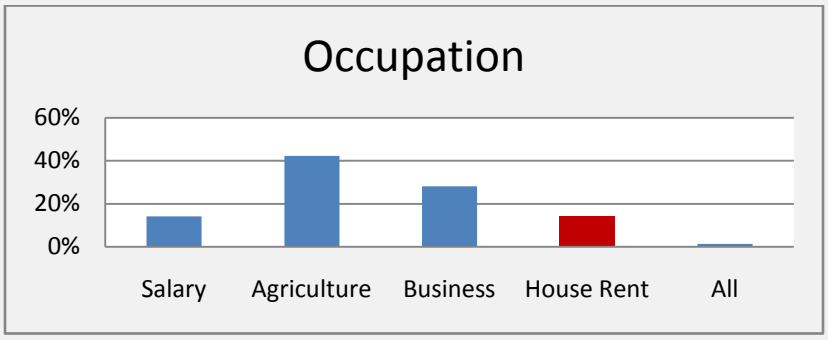

Figure 3.1: Occupations of the respondents

3.3 Service Level Functionality

The service level functionality is reflected by the adequacy, accessibility and quality of water supplied as well as reliability of the consumers to the water. The household survey revealed the dissatisfaction of consumers with regards to both quantity and quality of water in general. Though there are other concerns as well, the quality aspects came out as the most prominent issue. Also most of the households have experienced reduced quantity of water.

3.3.1 Quantity

According to the project office, water is supplied twice daily for three hours in the morning and three in the evening. However, most households are getting water once a day, either in the morning or in the evening. Figure 3.2 shows that only 7% of the respondents get the supply twice a day as claimed by the scheme. Surprisingly, two respondents were elated as they get water all day long. The possible explanation for this could be some technical glitches related to pipelines. The supply hours ranges from half an hour at some locations to 4 hours at the others. The respondents seem to be aware of this situation and hence, demand for the uniformity in the quantity supplied. Some also stated that they are not well informed about the timing of the supply. They get water in the morning or in the evening which causes inconvenience to them. They wished there had been a fix time for supply.

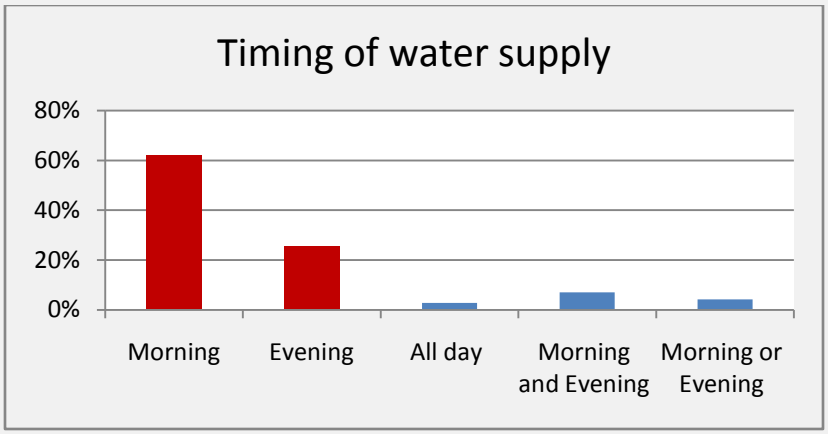

Figure 3.2: Timing for water supply

The users have felt that quantity of supply has been reduced over the time. According to 54% of the respondents, the supplied is inadequate or only partly sufficient. They are meeting the requirement using *Kuwa* or by tapping nearby spring sources such as Pahare, Chisapani, Dharapani and Okhale or buying Jar water from the market (See Table 3.6). They attribute this change to increased population and settlements (70%) and about 6% respondents accuse the institution for not being able to manage the demand. The participants of FGD also mentioned various factors responsible for the situation but most of them agreed that drying of the spring sources and increased number of users are the major culprits.

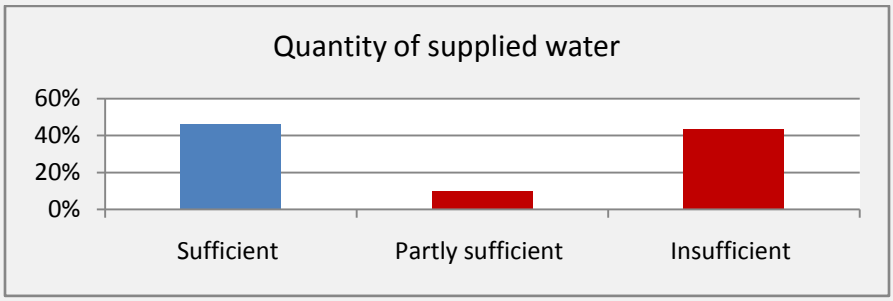

Figure 3.3: Sufficiency of supplied water of KSTWSSSP

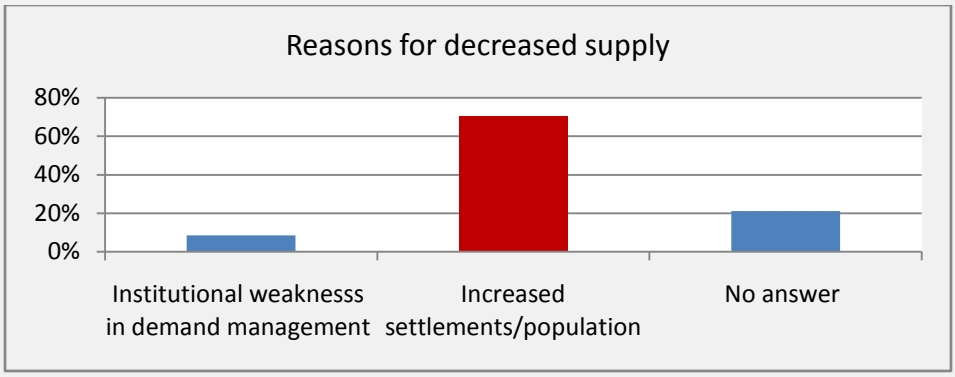

Figure 3.4: Reasons for decreased supply

3.3.2 Accessibility

There are piles of new applications at the office and the applications are increasing day by day. The scheme is well aware of the rapidly increasing demand for water. On the supply side, the authorities are looking for potential sources of water. They have recently opted for groundwater extraction. Suklagandaki municipality is experiencing haphazard urbanization like many other places in Nepal. Since it lacks urban planning, there is no sufficient road construction and expansion. Moreover, the plotting of land for new settlements from the private sector is growing which is least bothered about leaving enough space for roads. This has caused inconvenience in laying water connection pipelines for new consumers.

Khairenitar STWSSSP is well known for its pro-poor policy. To ensure the accessibility of the poor households, it provides subsidized connection fee. The system identifies three categories of households, very poor, poor and general and has set the connection fee accordingly (See Table 3.5)

Table 3.6: Connection fee structure for different household categories

S. N.	Economic category of household	Private tap connection fee	Provisions	
			Application charge	Installment period
1	Very poor	7,800	1,000	24 months
2	Poor	12,200	2,000	12 months
3	General	15,000 + 10% interest	3,000	12 months

Source: Gaudel 2010 & Field visit at KSTWSSSP, 2017

The system is appreciated by the users for being considerate to the poor. At the same time, the downstream (tail-end) users seemed to be unsatisfied as their access to water is limited due to various reasons. One of the reasons is water being pumped by the upstream users which results in decreased water flow towards the end of distribution system. The users at those parts experienced lesser supply as well as reduced water pressure in the pipe.

3.3.3 Quality

Quality of supplied water is a big concern for the users. Sixty five (65) percent of the respondents said that the quality of the water has degraded. Turbidity, silt and foul smell in water have compromised the quality forcing the users to look for alternative sources for drinking purpose. About 52% of the respondents informed that they are using Kuwa or tapping nearby spring sources such as Pahare, Chisapani, Dharapani and Okhale or buying Jar water from the market. Only 10% are using the supplied water for drinking while others utilize the supplied water for other domestic uses such as bathing, washing, cleaning and irrigation. Some collect rainwater and river water when the supply is low. Only 18% of the respondents do not treat water before drinking while rest of them treat water either by filtration (52%) or boiling (30%) before consumption.

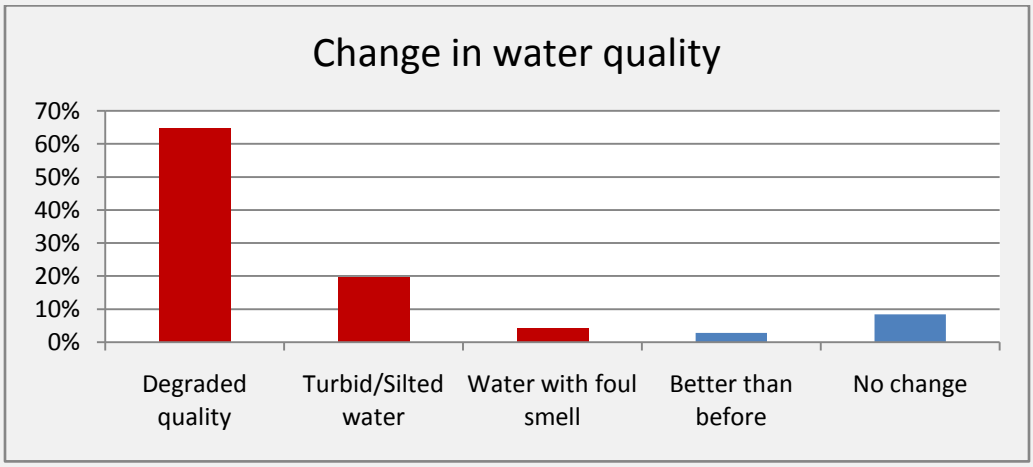

Figure 3.5: Observed changes in water quality

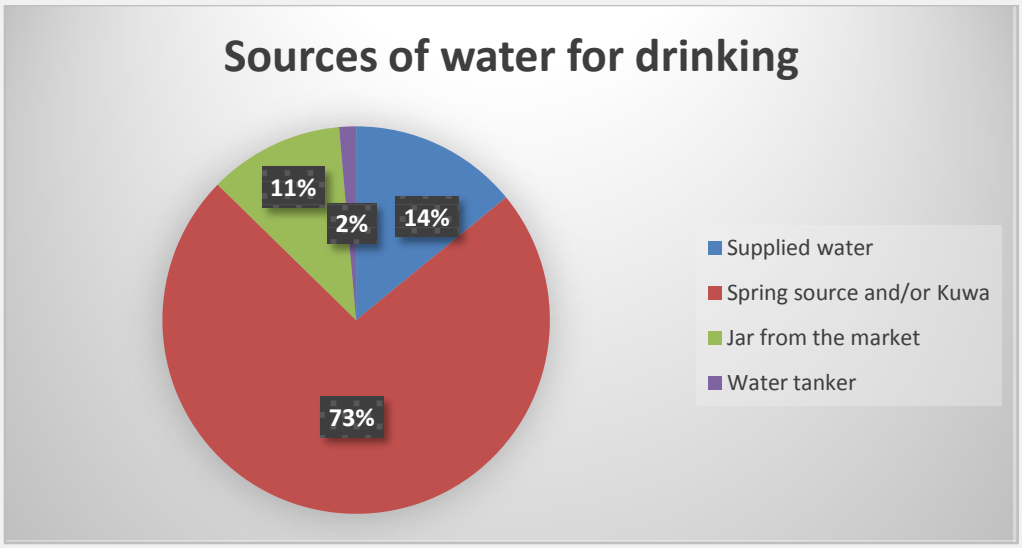

Figure 3.6: Sources of water for drinking purpose

The scheme had used spring sources in the early years. In order to meet the growing demand, the river water as well as underground water has been utilized. The users do not seem to be happy about it as this led to degradation of water quality. Thirteen (13) percent of the respondents claimed that ever since the boring water has been distributed, they felt the change. Some think that the storage tanks are not cleaned regularly while some think that it is due to mixing of river water and insufficient treatment. Some users also blame the institution for being careless about the quality of water supplied. According to 46% of the respondents, the supplied water has caused many health issues to them such as skin allergy, itching, hairfall, dandruff and even diarrhea. The officials although claimed that there has been no diseased cases reported in the hospital due to consumption of supplied water till date (according to a research done by KSTWSSSP). But it is also true that the system owns only basic type of treatment facilities such as sedimentation unit, sand filters and chlorination units which could not remove dissolved solids completely. During the survey, some households also responded that the silt (lime) loaded water has ruined the meters forcing them to replace the meters earlier than anticipated.

3.3.4 Reliability

The water supply is largely intermittent as indicated by 97% of the respondents. The distribution is very uneven throughout the system. The tail-end users are usually the

sufferers as the water pressure decreases along the pipeline. The water pressure decreases along the pipeline. The supply hours also vary throughout the system. Some also stated that they are not well informed about the timing of the supply. They get water in the morning or in the evening which causes inconvenience to them. They have to wait and anticipate the supply timing due to which a considerable time is wasted. They wished there had been a fix time for supply so that they could adjust their daily schedule accordingly.

On the technical side, users are mainly concerned about issues related to connection. A large proportion of the respondents (61%) criticized for not getting timely connection while some stated that the quality of equipment used for pipeline connection is low (6%). Some also believed that they need political recommendation for getting things done quickly. Due to these reasons, the system is perceived to be unreliable. The FGD participants also narrate the similar stories.

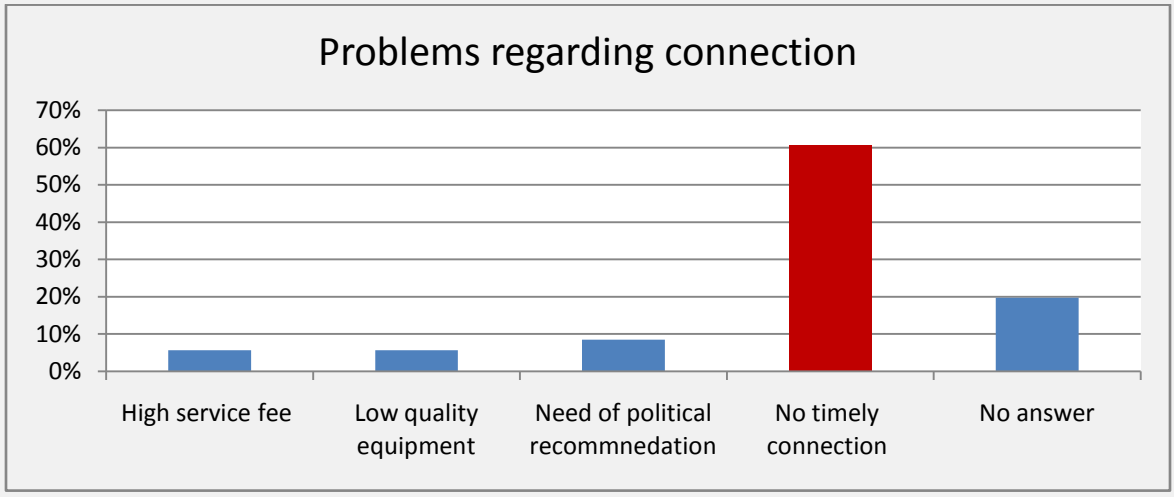

Figure 3.7: Issues regarding technical service

3.4 Cost of water service

The customers have to pay a minimum of Rs. 120 per month for maximum 10 m^3 of water used. With additional water usage, the increase in unit cost is applicable (Table 3.4). Although, the unit charge is higher than in big cities like Kathmandu, the collection of water charge has not been difficult for the system. The customers reported that they are more than happy to make the payment if they get adequate water in a timely manner. During the survey, the 76% of the respondents reported that they are paying more money because the

water usage at household level has increased quoting various reasons for that (Figure 3.9). Most of them (56%) said it was due to increase in the number of users at house, mainly because of the renter population. Some of them (23%) also think that the consumption pattern has changed over the years. This basically refers to increase in per capita water use. It is a general behavioral change regarding water use when a rural area takes an urban form. People tend to use more water for cleaning, bathing and other domestic works. Some respondents mentioned that the institution is unable to fix their malfunctioning meters in time forcing them to pay more due to faulty equipment. Similarly, some of them keep their taps open as the timing of supply is not fixed which led to rise in meter reading.

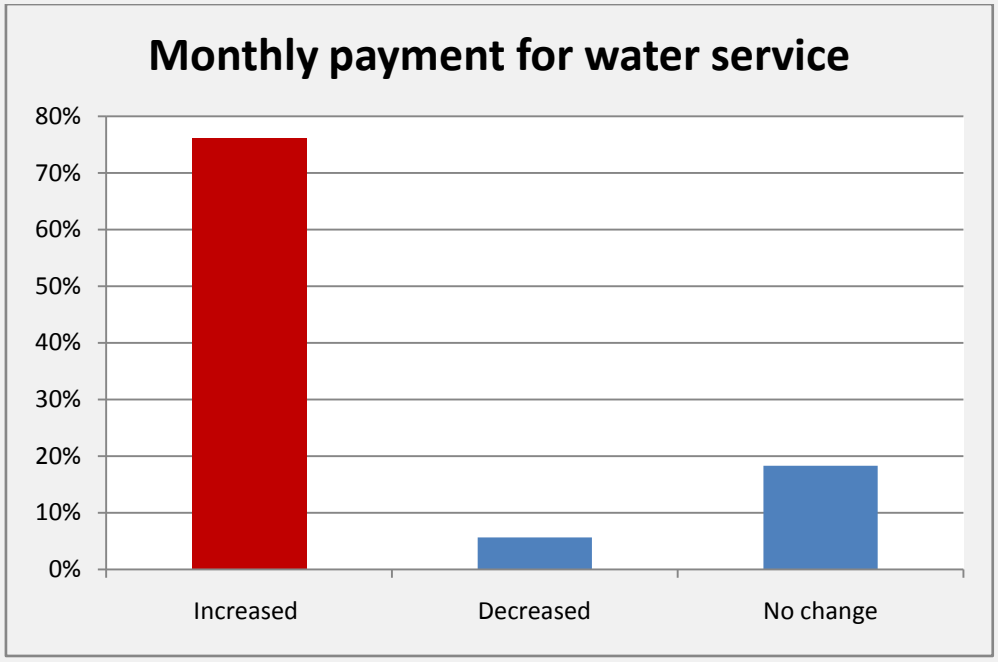

Figure: 3.8: Monthly payment for water

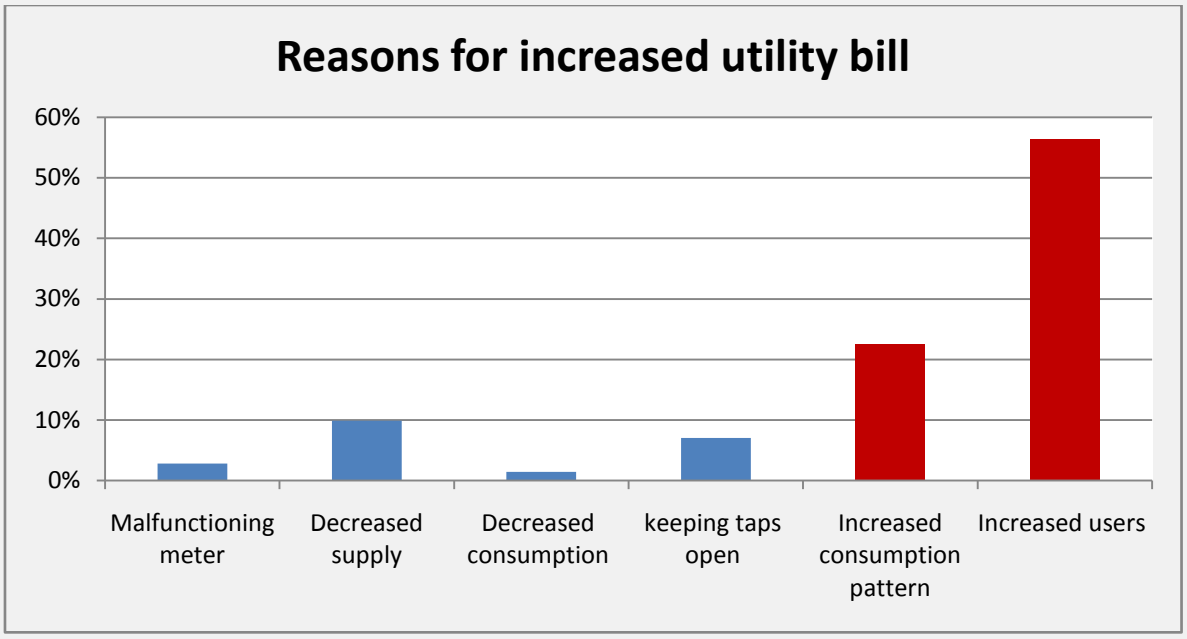

Figure 3.9: Reasons for change in payment for water

3.5 Management/Institutional challenges

3.5.1 Population growth:

Khairenitar STWSSSP was initially designed for about 808 households of wards 8 and 9 of Khairenitar, which had the status of VDC then. Now, the service area has been expanded as the VDC has been merged with two other VDCs to form Suklagandaki municipality. Currently, the system is serving 1,344 households. The estimated beneficiaries are about 10,000 with around 3,000 temporary residents. Khairenitar being the economic hub of the area, it has been facing high rate of population growth, mainly owing to high rate of migration. One reason (among many others) as quoted by many participants

Figure 3.10: Army barrack at Khairenitar bazaar

of FGD was the establishment of army barrack in Khairenitar bazaar which led to migration of families along with 1,800 employed army personnel. The number of renter population has thus swollen. The system was formerly planned considering about 2 - 2.3% of urban growth rate. According to the officials of KSTWSSSP, the area has unprecedented 6.69% rate of migration (as per the survey conducted 2/3 years ago) along with normal 3% annual population growth. The project was planned for 15 years but it could not cope with the rapid pace of urbanization. It required rehabilitation before 15 years. Currently, it is being is putting the system under great pressure rehabilitated under Third Small Town Project supported by ADB.

3.5.2 Source of water:

Finding a reliable water source has turned up as a big challenge. The available spring sources have been drying. For instance, the water flow at Jamdi source was 6 lps initially which has reduced to 5 lps now. Similarly, the other sources from which the system is tapping water for supply are also facing the decline of water flow (Table 3.1). On the other hand, due to the source debate for drinking and irrigation uses of water, finding a safe and reliable source has been a daunting task for the system management team. The members of KSTWUSC are aware about the changing situation of service area and rising demand for water. During the FGD, they expressed the difficulty faced while hunting for new sources for the system. They could finally augment water from Jamdi River and underground water through deep boring to meet the demand to some extent. The water quality of newly found sources is not very good. The groundwater is contaminated with iron for which the system does not have a proper treatment plan and equipment. The respondents of household survey also perceived that the quality of water has been deteriorated even since water from new sources was supplied to them (Figure 3.11).

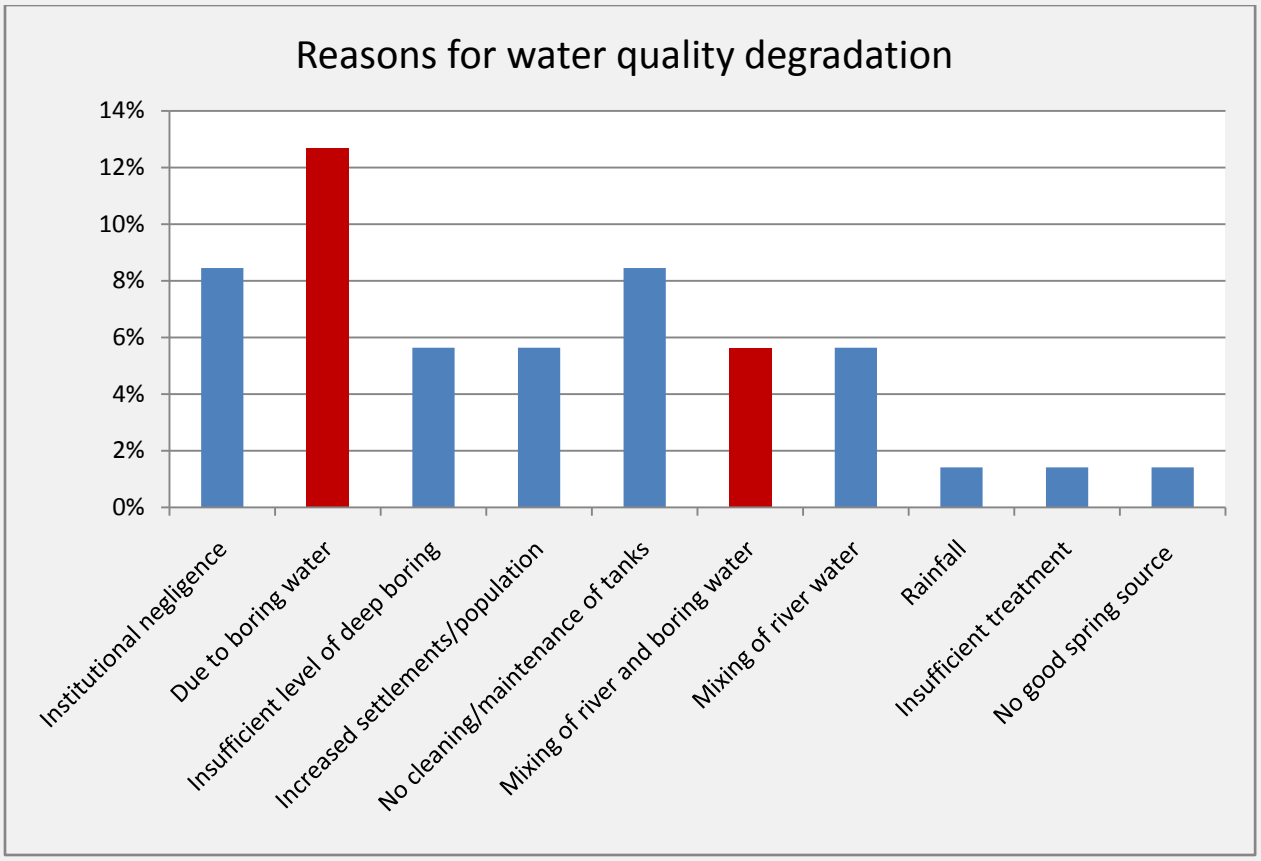

Figure 3.11: Perceived causes of water quality degradation

One of the neglected aspects of water quality is related to land use. For instance, there are agricultural land upstream of Jamdi River from where the water is tapped for the system. People cultivate different crops including spring paddy. Farmers are found to be using chemical fertilizers and pesticides extensively. The runoff from those fields is highly likely to pollute the Jamdi River source. In order to protect the source, immediate actions for such activities are deemed necessary.

3.5.3 Insufficient staff

The number of staff, technical staff in particular is largely insufficient for the overall operation and maintenance of the system. Currently, it has got only 50% of the total staffs required. This is one of the limiting factors for providing timely service to the customers. The system is in dire need of full-time engineers to fix the technical malfunctions. The system is obliged to let plumbers handle those works which are supposed to be of engineers. Similarly, there are only two staff handling the administrative works. The

pressure of work is growing for them with escalating number of consumers. Although, the KSTWSSSP is trying to digitize the system, it will still take some time for that to happen fully.

3.5.4 Treatment facility

The system is equipped with sedimentation filter, pressure sand filter, horizontal-flow roughing filters, a slow-sand filter and chlorination units. The consumers' complaint regarding silt, odor and color caused by iron could not be addressed with the available facilities. The silt content (lime) is likely to wear the equipment as well as decrease the capacity of pipelines as it settles. Figure 3.12 shows the desiccated silt found in the water. The FGD participants also reported that lime has affected one of the sources as well. Similarly, figure 3.13 shows the treatment method used for aeration of groundwater in order to oxidize iron. The method is however very less efficient in removing iron. Unfortunately, the system does not have any other treatment option till date.

Figure 3.12: Desiccated lime found in water

Figure 3.13: Perforated trays for oxidizing iron content in groundwater

The participants of FGD believed that the energy cost for pumping underground water is very high and is unsustainable. They also ascertained that the money used for buying diesel could recruit 2 or 3 extra staff. But in absence of suitable alternative source, the management team cannot overlook the deep boring.

However, the recent augmentation of treatment facility (pressure filter) to the system has been a good effort from the supply side. On top of that, the supplied water is tested in the lab twice a year. The recent test report suggests that the water quality parameters are

within national standard except for the iron content of underground water. But currently, the system is not supplying underground water and hence, the supplied water is not posing threat to public health. Moreover, the WUSC is committed to solve the problem in near future.

According to the members of WUSC, consumers are using water from nearby natural sources for drinking apart from supplied water. KSTWSSSP had conducted water quality tests of such sources in the past and found four of the sources to be contaminated with coliforms. So, they believe people often accuse KSTWSSSP even if they get sick due to consumption of water from those sources.

3.5.5 Distribution network and size of the pipeline

Many users in the downstream areas complain about low water pressure in the pipe. The officers of the officers also admit the situation and reported that with the current size of pipelines, it is hard to provide justice to the tail-enders. With the existing distribution pipelines, only 500- 600 households can be served further. In order to maintain the water pressure throughout the length of pipelines, old pipes should be replaced with new ones having bigger dimensions.

3.5.6 Source preservation

The protection of sources from human activities, cattle and disasters is essential in order to maintain the water quantity as well as avoid quality issues. In KSTWSSSP, there is a simple barb wire-fencing around the sources to prevent people from going there. Similarly, the locals are requested not to dump solid wastes near the sources. Other than that, no safety measures have been taken.

Some sources have been found dry in recent years, especially after the devastating earthquake of 2015. As informed by the WSUC members, groundwater extraction at 4/5 places have taken place without any technical study and potential impacts to nearby sources. They asserted that such activities are likely cause drying of highland water sources.

3.5.7 Sanitation

No significant activities have been carried out for sanitation. The system is more focused on providing water. Although the municipality has been declared as Open Defecation Free (ODF) zone, there has not been any technical works for wastewater and storm water management. Mr. Shreeram Subedi during the interview underscored the importance of installing drainage facilities as he pointed out that a large share of supplied water is non-consumptive and is drained out of the households in the form of wastewater. He laments that the system has not been considering much on this fact. On the other hand, members of KSTWUSC proudly mentioned that KSTWSSSP has allocated 15% of its budget for development and rehabilitation of sanitation (sewerage system) which is generally 5% in fresh projects. Thus, they hope to see some good initiatives in sanitation sector as well.

3.6 Impacts of urbanization

It is very clear that Khairenitar water supply system is being affected by urbanization in the area. Urbanization in Khairenitar is mostly attributed to migrating population from the adjoining districts and hills, facilitated mainly due to road connectivity and access to market in Khairenitar bazaar. Its close proximity to Kaski district (mainly Pokhara, the tourist hub of the country) is also responsible for its rapid urbanization.

The impacts of urbanization are prominent in terms of quantity of water supplied. This was also revealed by the household survey where most of the respondents agreed upon the fact that increased number of people and settlements has resulted in decline of water supply and its inadequacy (See Figure 3.3 and 3.4). Since the service area of the system expanded with the upgrading of Khairenitar VDC into Suklagandaki municipality by merging with two adjacent VDCs, the water supply scheme has to adjust accordingly. Although the scheme claimed that they are supplying water twice a day for six hours, the customers had different stories. They used to get water in the morning and evening in the past, not now. They only get either time of the day which is not adequate for drinking and other domestic purposes. That is why, they have been using alternative sources too such as nearby spring source or jar and tanker water for meeting their daily needs.

One of the reasons for inconsistency in water supply has been lack of rehabilitation in distribution system. Existing distribution pipelines are unable to serve the expanded service area. Even with the increase in the width of the pipeline, the problem has not been solved. Such technical glitches are difficult for general public to comprehend which made them complain more. The only solution is to rehabilitate the pipelines completely.

The demand for water is however increasing evident through mounting new applications. Demand management has been a challenge as the system has limited staff (technical and non-technical) as well as limited scope for expansion. Moreover, the lack of new sources (reliable, dispute free and of acceptable quality) is testing the viability of the system in an urbanizing context. If the system could not be rehabilitated with necessary physical and human resources, it is likely to make the situation worse.

CHAPETR IV

CONCLUSION & RECOMMENDATION

Khairenitar STWSSSP, like many other small town water supply scheme, is being challenged by growing population and growing preference of people to live in urban areas. The government of Nepal is likely to depend upon small town water supply and sanitation schemes to deliver water to the newly emerging urban territories. Some of the challenges of such schemes as pointed by Adank (2013) hold true for KSTWSSSP too. For instance, the unit cost of water is higher in small town than that of large city. Similarly, the dynamic nature of small town calls for constant revision of the water tariff, system modification and adjustment.

KSTWSSSP was initiated about 13 years ago, although designed for 15 years, it needed rehabilitation sooner. Currently, it is under rehabilitation process. The system urgently needs to be expanded to cover more households. The major reasons behind this requirement are growing urbanization and expansion of service area as a result of conversion of VDC into municipality. The system is struggling to acquire water because finding a good alternative source has not been easy while the existing distribution system has limitation to expand much.

The issue with demand side is mostly related to quality of water while that with supply side seems to be more of managing the quantity of water as per the demand. Both the service providers and consumers have felt a reduction in water supply. Both parties attribute this to growing migration of people and expanding settlement in the municipality and drying of sources. The reduction in discharge of water at sources is evident of this fact. Some consumers also think that it is due to the negligence of management while the members of KSTWUSC state that despite their endless effort, they have not been able to find alternative sources for a reliable supply of water. With the construction of OHT, the officials believe that additional reservoir will make the supply more reliable. Ever since the supply is

augmented by new sources (ground water and Jamdi River), the customers have been dissatisfied with the quality. The service provider also admits that no sophisticated facility is available for treating the iron content of groundwater. Nevertheless, the supplied water has not caused any serious health issues to the users.

The application for new connection continues to grow but providing the connection service to new customers is being lingered by unplanned urbanization and insufficient number of staffs (technical as well as administrative). It is difficult to connect and expand new pipelines with the previously installed distribution network which was meant for limited households. In order to have a functional distribution lines, the KSTWUSC thinks that the whole set of new equipment is required in the system. This will also maintain uniform water pressure in the pipes throughout the system which will increase the accessibility of tail-end users as well.

Regarding water charge, collecting the monthly tariff is not an issue till date. Although the unit cost is high as compared to bigger urban areas, the customers are willing to pay if they are ensured reliable water delivery. Nevertheless, some users nowadays are reluctant to make payment because they do not receive water timely. This happens usually during lean season and especially with the tail-end users.

The institution itself has few prominent issues that impede a quality service delivery. First of all, the number of staff is inadequate. It needs engineers who could be available for solving technical issues. The growing customers are adding pressure to administrative staffs and hence, they also need additional staff for handling mounting works. There is only one meter reader currently. With more household coverage in the municipality, additional meter readers are required. Similarly, capacity building opportunities for staff is also deemed necessary since a lot of issues in the system are being handled by plumbers. It will also help the administrative unit to switch easily to digitized system.

In a nutshell, KSTWSSSP has been benefitting more than 10,000 people in Suklagandaki and is likely to serve more in coming days. Urbanization and migration of people in the municipality is challenging the system in many ways. If the system can be rehabilitated to address the growing issues, its sustainability is ensured.

Based on the research, some further research areas identified are as follows:

- The study has found out that some of the sources are drying out. But the reasons of discharge reduction at those sources have not been explored. The possible reasons could be climate change, urbanization, lack of conservation and so on. Hence, a detailed study focusing on water sources depletion and conservation is important as it has implications for the whole water supply system. Another important factor to be studied along with this is sustainable harvest of the water from the sources for the sake of ecosystem. Similarly, the long term impacts of groundwater extraction through deep boring, especially on other water resources needs to be examined through researches.

- Similarly, the nexus between land use and its impacts on water resources needs to be explored. This is important to protect the existing as well as potential water resources for the system. With the current trend of urbanization, the exiting sources must be augmented by additional sources and hence, source protection from harmful land use practices needs to be identified. This will help the water managers to take necessary measures timely.

- One of the concerns about supplied water was related to its quality and health implications. This provides the research prospect on identifying the relation between water quality and public health by also considering the alternative water sources that people are using and the awareness level of people.

- The Khairenitar water supply scheme had to undergo rehabilitation before the designed period. Urbanization might have called for the expansion of the system but this is also an indication of poor operation and maintenance. An economic analysis of the income (water tariff) and costs to the system (operation and maintenance) can enhance the knowledge on financial viability of the system and the associated gap.

- The Fourth Phase of ADB grant for small towns water supply and sanitation scheme should be working on rehabilitation of distribution pipelines as this is creating difficulties for the system to supply water in an equitable manner.

- In order to align urbanization and water supply, it is imperative to have coordination between the relevant agencies. For instance, the municipality should work closely with KSTWSSSP during municipal building permit process. Similarly, the commercial plotting agencies should tie up with KSTWSSSP in order to ensure the water supply from the service provider.

- There is no data available regarding water leakage. KSTWSSSP is trying to digitize the whole system in near future. Till now only the billing is computerized. Hopefully, technical data on system efficiency (equipment, pipelines etc.) will be easy to retrieve once the digitization is complete.

- Although it is a water supply and sanitation project, not enough attention is being paid in sanitation aspect. It is imperative to take both simultaneously to avoid environmental as well as socio-economic issues in the future to come.

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Annex

I. **Key Informants for KII**

1. Mr. Shree Ram Subedi, Chief Officer, KSTWSSSP
2. Mr. Krishna Bahadur Poudel, President, Ward no. 6, Suklagandaki Municipality

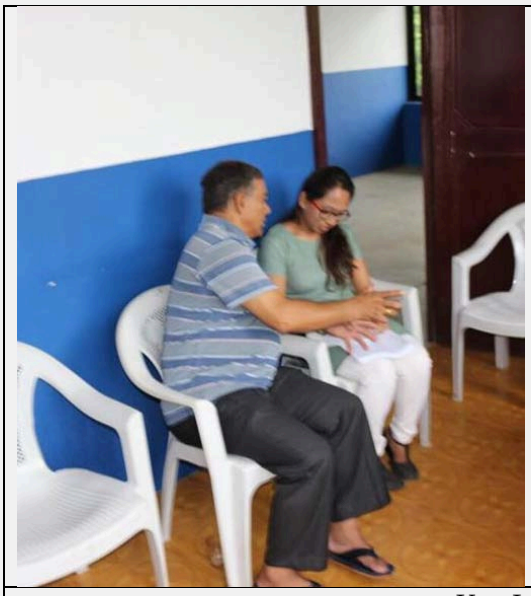
II. **FGD Participants**

S.N.	Name	Designation
1	Mr. Ram Chandra Uprety	
2	Mr. Shyam Bahadur K C	
3	Mr. Muktinath Timilsina	
4	Mr. Bhanubhakta Timilsina	
5	Mr. Sree Ram Subedi	Chief Officer, KSTWSSSP
6	Mr. Krishna Bahadur Poudel	President, Ward 6
7		

IV. Some snaps from the field

The newly constructed OHT

FGD with the members of KSTWUSC



Key Informant Interviews (KII)