My Journey in the Valley of Kathmandu, Nepal

An account of my 2013 Borlaug-Ruan Internship

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Acknowledgements

My journey in Nepal last summer would not have been possible without the contribution and belief of key individuals and institutions to today's youth.

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Gratefully,

Valerie Gamao

Background Information: ICIMOD

The **International Centre for Integrated Mountain Development (ICIMOD)** is a research and knowledge center focused on serving the needs of member countries surrounding the Hindu-Kush Himalayas- Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. ICIMOD is based in Kathmandu, Nepal and it aims to help the inhabitant of the Himalayan areas to successfully deal with issues of climate change and globalization through adaptive practices and awareness of existing issues.

Vision
Men, women, and children of the Hindu Kush Himalayas enjoy improved wellbeing in a healthy mountain environment.

Mission

To enable sustainable and resilient mountain development for improved and equitable livelihoods through knowledge and regional cooperation.

Reference: www.*icimod.org*

Part I: My Research

INTRODUCTION

Water suppliers on strike and Kathmandu Upatyaka Khanepani Limited's (KUKL**)** inability to meet current water demand are two popular headlines in Kathmandu Valley's newspapers. The Himalayan News service (2013) reported in July the disparity between the water demand of 350 MLD (million litres a day) and water supplies of 90 MLD and 150 MLD, dry and rainy season respectively, is indicative of the Valley's water crisis. Due to the insufficient and irregular water supply by KUKL, the Valley has witnessed the increasing need of households to utilize alternative water sources such as bore wells, dug wells, stone spouts and water-tankers. In particular, the role of private water tankers in the Valley has prominently increased as they took it to themselves to extract groundwater for personal use and for profit in order to meet household demands anywhere from 1-12,000 L per day (Dongol, 2012). Back when total water demand was just 320 MLD and an estimated 750 tankers were in operation, this commercial system is estimated to have met 8% and 4.8% of peak and off-peak seasons respectively (Dongol, 2012). These two major water providers in the Valley depend heavily on groundwater extraction with KUKL at 27% and tankers at 90% (Dongol, 2012).

KUKL took over Nepal Water Supply Corporation's (NWSC) jurisdiction over Kathmandu Valley's drinking and domestic water in 2008, but is still unable to adequately meet the Valley's ever-increasing water demand (Asian Development Bank [ADB], 2003). This demand rose in the early 1970s as urbanization took hold resulting in population increase and a largely unplanned process of industrialization. The need to fill housing needs later led to the development of high-rise buildings which concentrated and further exacerbated already high water demand (Dixit & Upadhya, 2005). While KUKL's ability to provide water lagged, the water demand of these commercial business and households grew which eventually led them to extract groundwater themselves, most often illegally. According to an interview of the Kathmandu Valley Water Supply Management Board (KVWSMB), "Out of total 800 million litres of groundwater being extracted daily, around 700 million litres is extracted illegally in the Valley" (Sharma, 2011). These illegal extractions are largely due to the growth in the demand for commercial groundwater sold to the tankers for supply to the public. (Dixit and Upadhya, 2005). Households also began to install their own pumps, build their own wells and purchase underground storage tanks to meet their water needs. As of 2011, 6% and 9% of households have tube wells and covered or uncovered (dug wells) respectively. The latter's unregulated extraction of groundwater in the Valley, magnified with difficulties of groundwater recharge due to decreased rainfall infiltration as direct result of haphazard urbanization and the presence of impermeable black clay making recharge slow in the first place, has significantly contributed to the lowering of the Valley's groundwater table (Jica, 1990; Pandey et. al 2010; Shrestha, 2009; Dongol, 2012). According to KVWSMB, all these things combined have contributed to the present lowering of the groundwater level at an estimated 4 meters per year (Sharma, 2011).

Existing research also show that the water available, regardless of source type, are of poor quality and require proper treatment before water is used for consumption. Water distributed in the valley is found to be contaminated with ammonium, iron and arsenic owing to the lack of proper treatment (Yoden & Chettry, 2010). An investigation of Bhaktapur municipality's drinking water sources found that 48.28% had iron levels exceeding the 200 ppm standard and total coliform levels were high (Diwakar et al, 2008). Similarly, 72% of water samples collected in Kathmandu Valley contained significant total coliform levels and standards for nitrate, ammonia, arsenic and mercury levels were also high (Warner et al, 2008). Researchers have cited poor maintenance and operation of water treatment plants, unrepaired pipelines, differences in pressure during water delivery causing suction of contaminants and close proximity between drinking and sewage lines as common explanations behind the poor water quality (Prasai et al, 2007; Diwakar et al, 2008; Sagara, 2000). Despite the contaminants cited by researchers, Yoden's research found that the majority households are satisfied with the water quality of their pipeline supply but 65-67% of them believe that the pipeline does contain health risks (Yoden, 2012) Research by Subedi and Aryal also found that households perceived jar water to be of good quality for drinking even though lab findings indicate that 91.2% of the jar samples were contaminated with total coliforms (with 59.6% fecal coliform contamination) (Subedi & Aryal, 2010).

It is popularly summarized that the Kathmandu Valley's groundwater crisis is "reflected in terms of depletion in groundwater level, decline in design yield of wells, degradation of groundwater quality and shrinking aquifer volume due to land subsidence" (Pandey et al, 2012, p. 7). Popular solutions to this water crisis are rainwater harvesting, groundwater recharge and the Melamchi project. Shrestha (2009) argues that designating just 10% of the Valley to rainwater harvesting would equal to 128 cu. m annual recharge. Through the use of GIS-based ARC modeling, Pandey (2012) recently found that shallow aquifers have a capacity to store around 6800 cu. m per pixel which lends more greater insight in marking areas that would be well-suited groundwater recharge developments. In regards to the Melamchi project, Jha and Shrestha's report challenges popular opinion that its delivery would solve the Valley's water problems. In their report, they anticipated decrease in precipitation due to climate change and questioned the ability of Melamchi to even meet future water demand considering the current rate of population growth (Jha and Shrestha, 2013).

Based on the literature discussed above, no study to date has looked at the specifics about the alternative water sources that households rely on even when given access to KUKL pipeline water. Secondly, no existing research has been done about the water quantity or quality available to households in the Lalitpur municipality. In this report, the Lalitpur municipality was chosen as the area of research to address these research gaps. Given the current status of water supply services of KUKL and water tankers, and the reliance on alternative water sources, it is clear that a more thorough understanding of how households are coping with the groundwater issue should be done. Their perceptions have to be recorded.

This report seeks to supplement the existing studies about the groundwater situation in the Kathmandu Valley by focusing on the water situation in the Lalitpur municipality which KUKL supplies with piped water. A questionnaire was developed to address the following study objectives:

1. To analyze how socioeconomic status and housing location both determine people's access to drinking and domestic water sources,
2. To understand the role of groundwater in providing the needs of the Lalitpur municipality,
3. To recognize how people are coping with the insufficient water quantity and poor water quality, and finally,
4. To figure out the solutions that can be made to address the water problem

DATA COLLECTION

Sample size and surveyed areas

This report presents data collected from the sub-metropolitan city and 10 VDCs in the Lalitpur municipality and within the service area of KUKL. The VDCs surveyed were Bungamati, Chapagun, Dhapakhel, Imadol, Kaleswor, Khokana, Sainbu, Sunakothi, Thecho and Jharuawarasi. Through random sampling, 351 household surveys were conducted in July 2013 with each Lalitpur area sampled according to population size.

Methodology

The data collection methods used was interviews and water samples from wells. Random household interviews were done using a structured questionnaire. Descriptive analysis was later performed to understand the perception of households to the water situation in the municipality and allow understanding of how the households are currently managing. the In households with a dug well within the housing premises, water samples were taken for lab analysis of iron-content level. The GPS of all household wells were also recorded to map their distribution in the Lalitpur area.

Questionnaire development

The questionnaire was developed based on information gained through literature reviews concerning Kathmandu Valley's groundwater crisis, examples of water surveys from various organizations, discussions with experts and feedback gained through a series of pre-tests. The questionnaire was developed to address the following four study objectives: (1) To analyze how socioeconomic status and housing location both determine people's access to drinking and domestic water sources, (2) To understand the role of groundwater in providing the needs of the Lalitpur municipality, (3) To recognize how people are coping with the insufficient water quantity and poor water quality, and finally and (4) To figure out the solutions that can be made to address the water problem

FINDINGS

Overview of Households Surveyed in the Lalitpur Area:

The surveyed households from rural and sub-metropolitan areas of Lalitpur generally show both similar and differing demographic and household information which provides the background information to understand the status of access and dependence to water sources. Table 1 shows that the sub-metropolitan city and VDCs both have an average of 5 household members and an average total household income of 10,000-15,000 rupies. Respondents were around 41 years old and are shown to have around 8.8 years of education with the education level higher in the city. Lastly, more than half of the total respondents (62.1%) were female. In terms of household information, 78.3% of the surveyed households are reported to be owners, total room number was found to be around 8 and around 9 people live in a typical household.

Table 1: Demographic characteristic of respondents

Location (Lalitpur)	Households (sample size)	Avg. # of household members	Household income per month (Rs)	Respondent Info			
				Avg. age	Avg. years of education	Sex	
						Male (%)	Female (%)
Sub-Metropolitan	231	5.6	10,000-15,000	42.2	9.5	103 (44.6)	128 (55.4)
VDCs	120	5.2	10,000-15,000	39	7.5	30 (25)	90 (75)
Total	351	5.4	5000-10,000 and 10,000-15,000	41.1	8.8	133 (37.9)	218 (62.1)

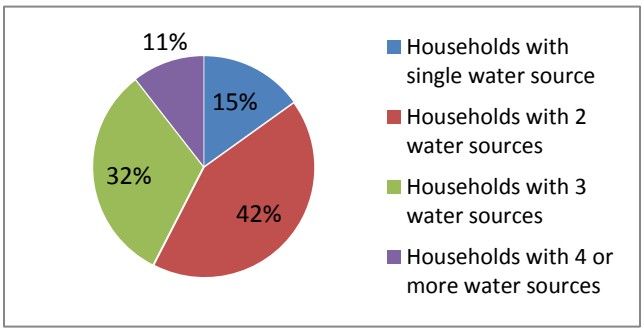
Table 2: Housing status of the respondents

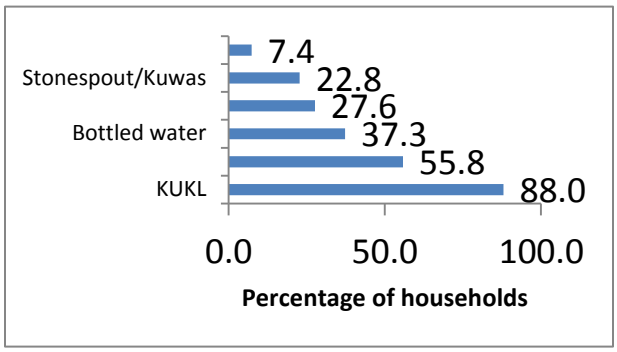
Location	Owner (%)	Renter (%)	Average number of rooms in the house	Average number of people living in the house (including household members)
Lalitpur Sub-Metropolitan	169	62	9.4	8.4
VDCs in Lalitpur	106	14	6.8	7.5
Total	275 (78.3)	76 (21.7)	7.9	8.7

Majority of Households Depend on More Than Two Sources of Water:

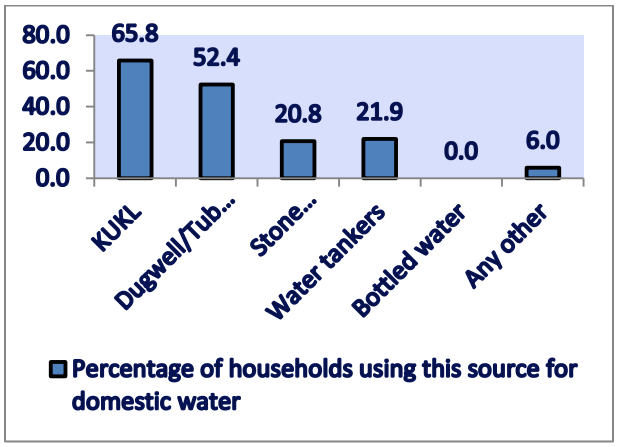
Majority of households depend on more than two sources of water. On average, households depend on 2.4 sources of water. These sources of water can be KUKL, water tankers, groundwater (dugwells, tubewells), and springs (dhunge dhara, springs). The survey also found that municipal pipeline,

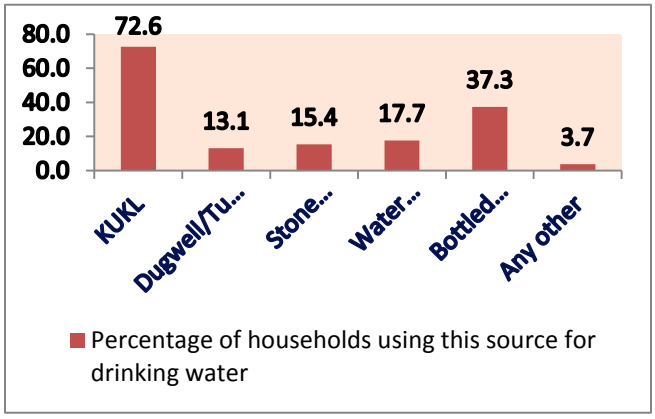
groundwater and purchased water are the most important sources of water. When it comes to groundwater, one in every two households have access to it.



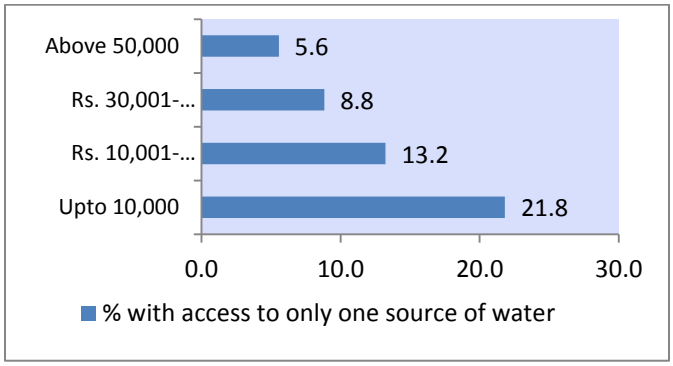


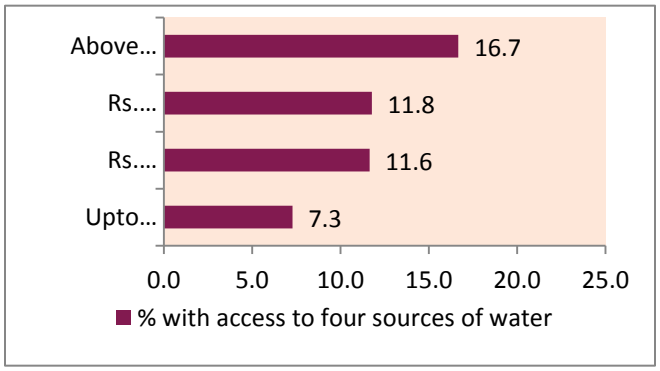
Different Sources are Preferred for Domestic and Drinking Water:
Different sources of water are preferred for drinking and domestic water. KUKL pipeline and groundwater are preferred for domestic use, while KUKL and bottled water are preferred for drinking. Groundwater is not preferred for drinking.



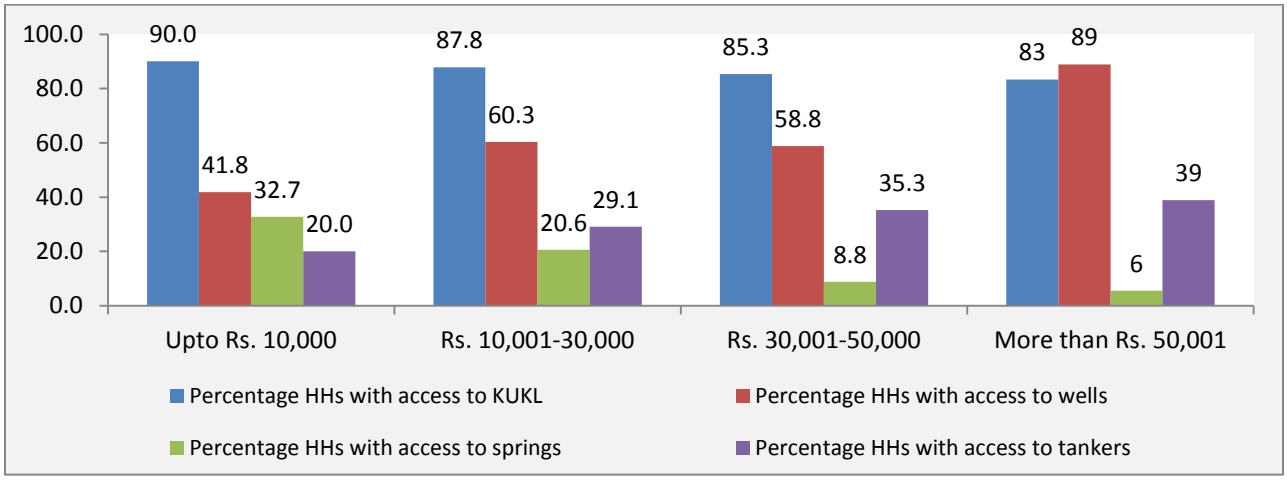


Access to Multiple Sources of Water is Partly Mediated Through Income
Of the 15% HHs (households) with access to only one source, 1/5th belong to the lowest income group. HHs in the highest income group are more likely to have access to four sources of water.

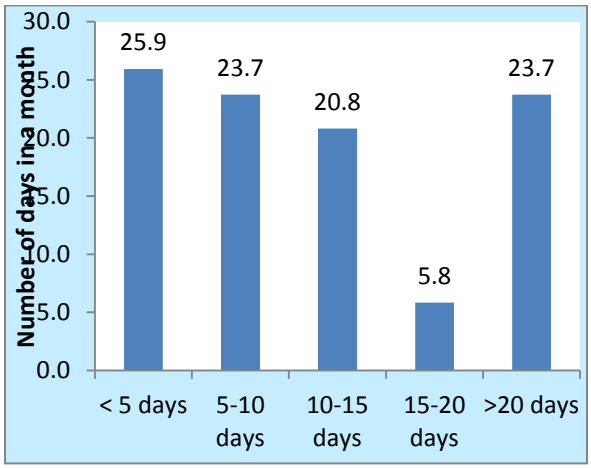


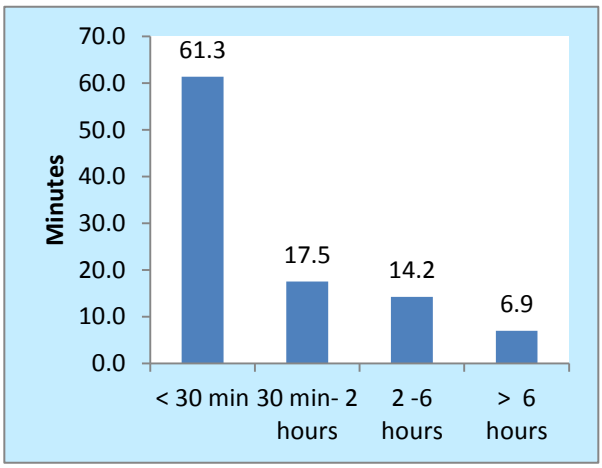


Dependence on a Particular Source is also Mediated Through Income:
Households in higher income groups are more likely to use groundwater and tanker water while households in the lower income groups are more likely to use springs. Interestingly enough, access to KUKL water is income neutral.



KUKL: Status of Pipeline Supply to Households
The KUKL pipeline is reported to be available to 88% (309) of the housholds surveyed, but almost 11% (33) of these connections are reported to no longer work in the recent years. The pipelines in the sub-metropolitan area are shown to be more dysfuntional than the pipelines in the rural VDCs. The KUKL water supply is found to deliver water an average of 12.8 days in a month which is equivalent to around 2-3 days a week. However, water is delivered at a significantly higher number of days and supplied for a longer period of time in the rural VDCs than in the city. Overall, the average number of minutes that water is supplied in the VDCs is almost double in comparison to the duration of water supply delivered in the city. When this water-time delivery is narrowed down to the number of minutes in a day, it was found that more than 60% of households only get water at less than 30 mins a day. Around 64% of the households surveyed know of the water delivery times in advance and among those, 67.8% report the schedule to be always followed. In terms of cost paid to KUKL per month, an average of 130 rupies is paid with city-users paying at a higher cost.





	Lalitpur Sub- Metropolitan Area (%)	VDCs in Lalitpur (%)	Total (%)
Details of supply			
# of consumers with water pipeline from KUKL	205	104	309 (88)
# of consumers with a functional pipeline	173	103	276 (89)
Avg. # of days in a month of water supply	8.03	20.7	12.8
Avg. minutes of supply each time	93.2	186.2	128.2
Avg. cost paid for water supply per month	149.3	106.1	132.9
Timeliness and predictability of supply			
# of people who know about water supply schedule in advance	114 (55.6)	84 (80.8)	199 (64)
# of people who do not know water supply schedule in advance	55	19	74 (36)
"How often is the schedule followed?"			
Always	68	66	135 (67.8)
Sometimes	39	16	55 (27.6)
Never followed	7	2	9 (4.5)

	Perceptions on quantity				**Perceptions on quality**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always sufficient	14	33	47	Very good	4	5	9
Usually sufficient	45	37	82 (29.9)	Good	65	89	154 (56.6)
Occasionally sufficient	28	10	39	Fair	21	37	58
Rarely sufficient	45	14	59	Poor	10	28	38
Never sufficient	38	9	47	Very Poor	3	10	13
	Perceptions on reliability				**Cost/price of water source**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total

Always reliable	14	27	41	Don't pay	28	21	49
Usually reliable	50	41	91 (33.3)	Very expensive	15	2	17
Occasionally reliable	25	11	36	Expensive	62	25	87
Rarely reliable	58	15	73	Reasonable	62	49	111 (40.5)
Never reliable	23	9	32	Cheap	4	5	9
				Very cheap	0	1	1

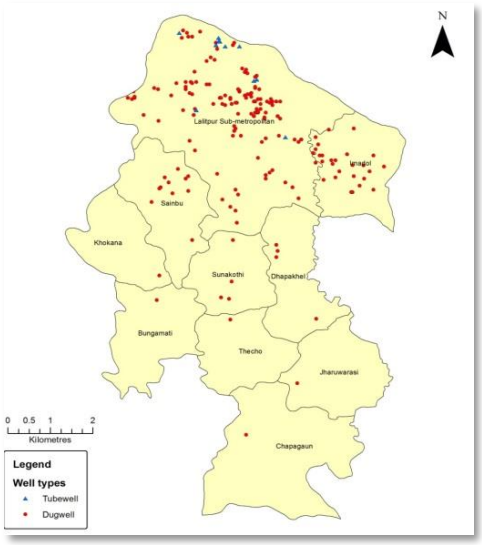
KUKL: Difficulties Experienced by Households and Suggestions to KUKL

Although the preceeding section shows the general approval of KUKL's performance, the primary difficulties cited by households still deal with the insuffciency and poor qaulity of the water delivered. This suggests that the sufficiency of water claimed by the respondents dealt with their perspective on KUKL meeting a specific role of their water need and that the problem of having "not enough water" can be explained with their reliance on alternative water sources other than KUKL. It is due to this insufficiency that the second most cited problem of unreliability of KUKL is cited. The difficulty regarding KUKL's poor water quality despite the general perception of it as "good" is also an indication that its quality still poses a concern by a majority of the households. When the households were asked about their suggestions on improving the water supply, a vast majority responded with the topic of increasing tapped sources of water in order to increase the volume water flowing thorugh the pipelines. The push for the completion of the long-delayed Melamchi project was a popular suggestion by the households.

Primary difficulties regarding piped water supply	# of responses	**Suggestions regarding improvement of piped water supply**	# of responses
Expensive	45	Treat water before supply	55
Not enough water	135	Increase water supply by tapping more sources (including Melamchi);	139
Inconvenient	29	Synchronize water and power schedule;	10
Reliability	80	Regular maintenance of pipelines;	7
Poor quality	78	Increase water storage at home;	6
Low pressure	44	Planned expansion of cities, roads and sewage;	7
No storage	5	Other suggestions (price water, ban electric motors);	7

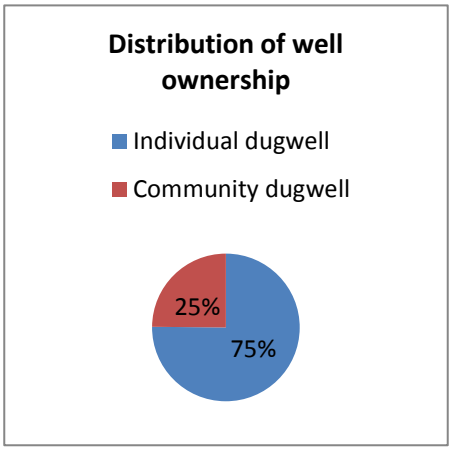
Frequent strikes	0	No suggestion	120
No one to fetch water	3		
No electricity	9		
Any other	25		
Don't know	77		

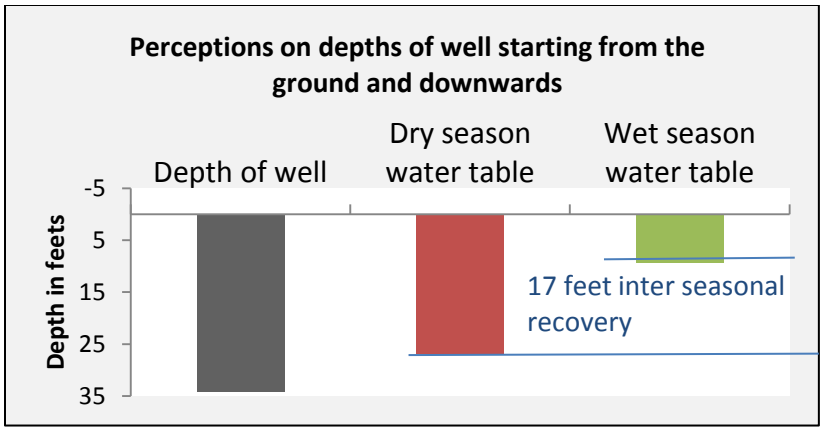
Groundwater: Status of Groundwater Extraction and Use by Households



Details about the direct groundwater use were analyzed in the household survey and it was found that 196 respondents (56%) reported getting water from dugwells (185) and tubewells (11). Tubewells were found only in urban areas and the details regarding it were ommited from this report.

In regards to dugwells, 75% are classified as individually owned while the rest are community wells. In the survey, respondents also answered questions about the details of the situuation of their dugwells to the best of their ability. The average well-depth is reported to be around 34 feet with a 17 feet water table recovery from dry to wet seasons. Respondents reported an average water table of 26.8 feet during the dry season and 9.4 feet during the wet season. When asked about the difference in water levels from now and 5 years ago, a very slight majority of the respondents say that the water is not declining (38.4%). The survey also asked respondents questions regarding any investment costs they know regarding their wells.





	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total
# of households who draw water from dugwells	134	50	185
# of dugwells not in use	7	1	8
Average depth of dugwell in feet (sample size)	34.5 (123)	33.4 (45)	34.2 (168)
Average water table during dry season in feet (sample size)	26.9 (121)	26.6 (46)	26.8 (168)
Average water table during wet season (sample size)	10.2 (121)	7.3 (47)	9.4 (168)
Overall water table now (sample size)	19.3 (95)	21.0 (29)	19.7
Overall water table 5 years ago (sample size)	15.5 (119)	17.5 (46)	18.9
# of respondents who think water level is declining	31	38	69 (37.3%)
# of respondents who think water table is NOT declining	13	58	71 (38.4%)
# of respondents who don't know about water levels	6	38	45 (24.3%)

Around half of the households (51.7%) found the quanity of water available in their wells as usually sufficient to fit needs. These needs usually came in the forms of washing day-to-day utilities and clothes. In terms of quality, an overall rating of "good" by 46.2% of the households was calculated. However, when the quality rating is narrowed down between what households in the city and rural areas think, VDCs report a fair to poor evaluation of the water's quality from their wells. In the ares of reliability, 55.4% of households report their dug wells to be always reliable in meeting their water needs. And finally, to those households who pay their respective communities for using the well, 32.6% report the price to be reasonable.

	Perceptions on quantity				Perceptions on quality		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always sufficient	41	25	66	Very good	12	4	16
Usually sufficient	72	19	91 (51.7)	Good	73	12	85 (46.2)
Occasionally sufficient	14	4	19	Fair	23	14	37
Rarely sufficient	0	1	0	Poor	14	15	29
Never sufficient	0	0	0	Very poor	5	4	9
				Not applicable (dry well)	7	1	8
	Perceptions on reliability				**Cost/price of water source**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always reliable	72	30	102 (55.4)	Don't pay	76	18	94
Usually reliable	47	16	63	Very expensive	2	1	3
Occasionally reliable	6	3	9	Expensive	12	10	22
Rarely reliable	1	0	1	Reasonable	41	19	60
Never reliable	1	0	1	Cheap	3	2	5
Not applicable (dry well)	7	1	8	Very cheap	0	0	0

Groundwater: Difficulties Experienced by Households and Suggestions for Well's Improvement

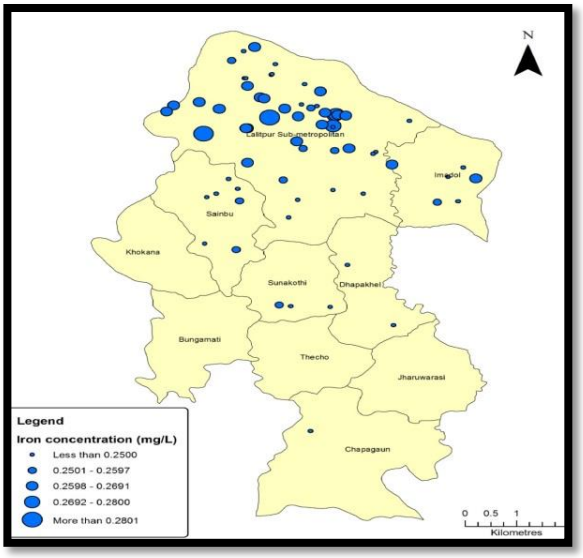
Poor water quality from the wells is a popularly cited difficulty by households and the problem of not being able to pump water when the electricity is down is another. When asked abou the suggestions to improve their dugwell(s), households popularly suggest both the testing for water quality and the push for keeping the immediate areas near the well clean.

Primary difficulties regarding well supply	# of responses	**Suggestions regarding improvement of well supply**	# of responses
Expensive	10	1 = Monitor water quality	30
Not enough water	11	2 = Keep area surrounding well clean	29
Inconvenient	1	3= Provide more electricity	8
Reliability	9	4= For community well, craft rules	3
Poor quality	55	5=Create awareness about groundwater	2
Low pressure	2	6= Invest in water storage	1
No storage	1	7= No suggestion	116
Frequent strikes	0		
No one to fetch water	3		
No electricity	14		
Any other	14		
No difficulty	92		

Groundwater: Quality Issues In Regards to Iron (Fe) Content

Water samples were taken in various dug wells that were within the household compound in order to check the iron content of the groundwater. From the collected samples, it was found that 64 dugwells showed iron content levels that were than 0.30 mg/L. This level is deemed permissible under the WHO guidelines. The low iron concentration was expected given the erratic changes in water levels in the monsoon season which was when the samples were collected.

Groundwater: Investment Costs of Dugwells



The survey also asked respondents questions regarding any investment costs they know of regarding their well(s). It was found that an average of investment of 33,000 rupies were for the construction of the well with a higher cost encountered by households in the VDCs. Households were then asked about their mechanism for water retrieval in order to calculate the operational costs of having a well. More than half of the households (53%) reported to use electric pumps which is calculated to cost households 380 rupies per month for pumping water after using the estimated values of 32 minutes per day the pump is used and the standard cost of 10 rupies per unit for utilized electricity (TABLE). Looking at the table, it is interesting to note the average price paid for the electricity used for pumping water and the number of minutes the pump is used is higher in the sub-metropolitan than in the rural VDCs. This potentially suggests a greater degree of water need felt by the people living in the city.

	Lalitpur Sub- Metropolitan Area	VDCs in Lalitpur	Total
Manual	55	26	83
Electric	69	23	92
Avg. HP of electric pumps	0.47	0.68	0.67
Minutes of pumping/day	35	27	32
Unit cost of electricity (Rs/unit)	10	10	10
Average electricity bill for pumping water/month	430	300	380
Average investment cost of making a dugwell	26453	37300	33311

Water Tankers: Market Relationship Status Between Water Tankers and Households

The survey showed that 30% (120) of the households surveyed utilize water tankers as a means for an alternative water source. The sub-metroplitan city, in particular, use the water tankers more than the rural VDCs. On average, households use water tankers 10 times in a year with an average amount of around 5700 liters bought and 1600 rupies paid each time. When the cost is stretched to a year, it was calculated that an average of 17000 rupies is spent by a household. A value that more closely resembles the cost paid by city users. The volume of water bought per month was also calculated to be around 4, 817 liters which signifies a good deal of dependence of water tankers by households.

	Lalitpur Sub- Metropolitan Area	VDCs in Lalitpur	Total
# of respondents who avail of tanker water	78 (34)	24 (20)	102 (30)
Average number of times tankers were ordered (May 2012 - June 2013)	11.5	7.5	10.6
Average amount of water bought per time in litres	5019.5	7812.5	5689.8
Average price paid per tanker of water (Rs.) each time	1523.7	1806.25	1590.8
Total money (Rs) spent on buying tankers per year	17522.55	13546.875	16862.48

Overwhelmingly, households perceive the cost of buying tanker water as expensive but the perceptions regarding the quanity and quality of water delivered and the reliability of service was rated similarly to the other water sources. The quantity delivered was seen as usually sufficient to fill household needs by 55% of the respondents, the quality of water was rated "good" by 67% of the respondents, and 53% of the respondents found the water tankers to be usually reliable. The quantity was seen as "sufficient" by the respondents because they would often just buy what they would need and nothing more. The quality was likely rated to be of good quality because of their perception of it bein g collected in a tank. And finally, water tankers are seen to be very reliable because the households are always assured of water even though the cost is high.

	Perceptions on quantity				**Perceptions on quality**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always sufficient	24	12	36	Very good	12	1	13
Usually sufficient	44	12	56 (55)	Good	47	21	68 (67)
Occasionally sufficient	5	0	5	Fair	14	1	15
Rarely sufficient	4	0	4	Poor	5	1	6
Never sufficient	1	0	1	Very poor	0	0	0
	Perceptions on reliability				**Cost/price of water source**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always reliable	41	13	54 (53)	No cost	0	0	0
Usually reliable	30	6	36	Very expensive	17	3	20
Occasionally reliable	2	2	4	Expensive	44	14	58 (57)

Rarely reliable	5	2	7	Reasonable	16	7	23
Never reliable	0	1	1	Cheap	1	0	1
				Very cheap	0	0	0

Water Tankers: Difficulties Experienced by Households and Suggestions to Water Tankers

The number one complain by households when it comes to using water tankers is its high cost. Using the data collected from the survey, it is calculated that the average cost per month of using a water tanker is around 1,230 rupies. A pricetag that makes it 8x more expensive of a water source than the average 153 rupies paid by households to KUKL per month. A secondary concern that households have is the unpredictable quality of the water supplied by water tanker. There are times when the water paid for is of poor quality and the households have no choice but to use it. Logically, when households were asked about their main suggestions to improve water tanker supply, they primarily suggested the improvement of water quality and reduction of the price.

Primary difficulties regarding piped water supply	# of responses	**Suggestions regarding improvement of piped water supply**	# of responses
Expensive	47	Improve water quality;	32
Not enough water	7	Reduce price;	16
Inconvenient	2	Timely delivery;	6
Reliability	10	Only government should operate tankers;	6
Poor quality	19	Better road facilities needed;	1
Low pressure	0	None	21
No storage	3		
Frequent strikes	1		
No one to fetch water	0		
No electricity	0		
Any other	0		
No difficulty	31		

Springs: Status of Dhunge dharas and its Use by Households

According to TABLE, stone spouts are currently used by 19% of the respondents surveyed. The average distance from the house to the stone spouts is reported to be around 440 m with a travel time of about 10 minutes. On average, respondents depend on one stone spout and half of the respondents utilize the stone spouts daily. Water in the stone spouts is found to flow during both seasons by two-thirds of the households while the rest responded that water only flowed during the wet season.

	Lalitpur Sub- Metropolitan Area	VDCs in Lalitpur	Total
# of respondents to collect water from Dhunge dharas	43 (18.6)	24 (20)	67 (19)
Avg. distance of DD from respondent's home (m)	450.7	428.9	442.9
Avg. travel time to fetch water (min)	9.77	9.5	9.67
Avg. number of DDs households depend on	1.42	1.46	1.43
Frequency of use of DD by the household?			
Daily	23	11	34 (50.7)
Weekly	12	8	20 (29.9)
Monthly	6	4	10
Rarely	2	1	3
When does the water flow in Dhunge dhara?			
Dry season	0	0	0
Wet season	20	2	22 (32.8)
Both	23	22	45 (67.2)
Does not flow	0	0	0

Households percieve the water they obtain from the stone spouts as usually sufficient to meet the water needs (43%) and more than half the households (58.2) judge the quality of water as "good". Among the households who depended on stone spouts, 60% rated it as "always reliable". And when it comes to cost, a huge majority of households (94) do not pay anything but the few users who were charged to use the spouts found the price reasonable.

	Perceptions on quantity				**Perceptions on quality**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always sufficient	14	9	23 (34.3)	Very good	8	12	20 (29.9)
Usually sufficient	17	12	29 (43.3)	Good	27	12	39 (58.2)
Occasionally sufficient	9	0	9	Fair	3	0	3
Rarely sufficient	3	2	5	Poor	5	0	5
Never sufficient	0	1	1	Very poor	0	0	0
	Perceptions on reliability				**Cost/price of water source**		

	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Always reliable	21 (31.3)	19 (28.4)	40 (59.7)	No cost	39	24	63 (94)
Usually reliable	18 (26.9)	2	20	Very expensive	0	0	0
Occasionally reliable	4	3	7	Expensive	1	0	1
Rarely reliable	0	0	0	Reasonable	3	0	3
Never reliable	0	0	0	Cheap	0	0	0
				Very cheap	0	0	0

Springs: Difficulties Experienced by Households and Suggestions for Dhunge dhara's Improvement

When asked about the difficulty regarding wells, those who had a difficulty found water from wells to be of poor quality. Popular suggestions to improve this water source are by simply keeping the stone spout's surroundings clean and a push for a mechanism that will allow water to be collected and delivered to each household.

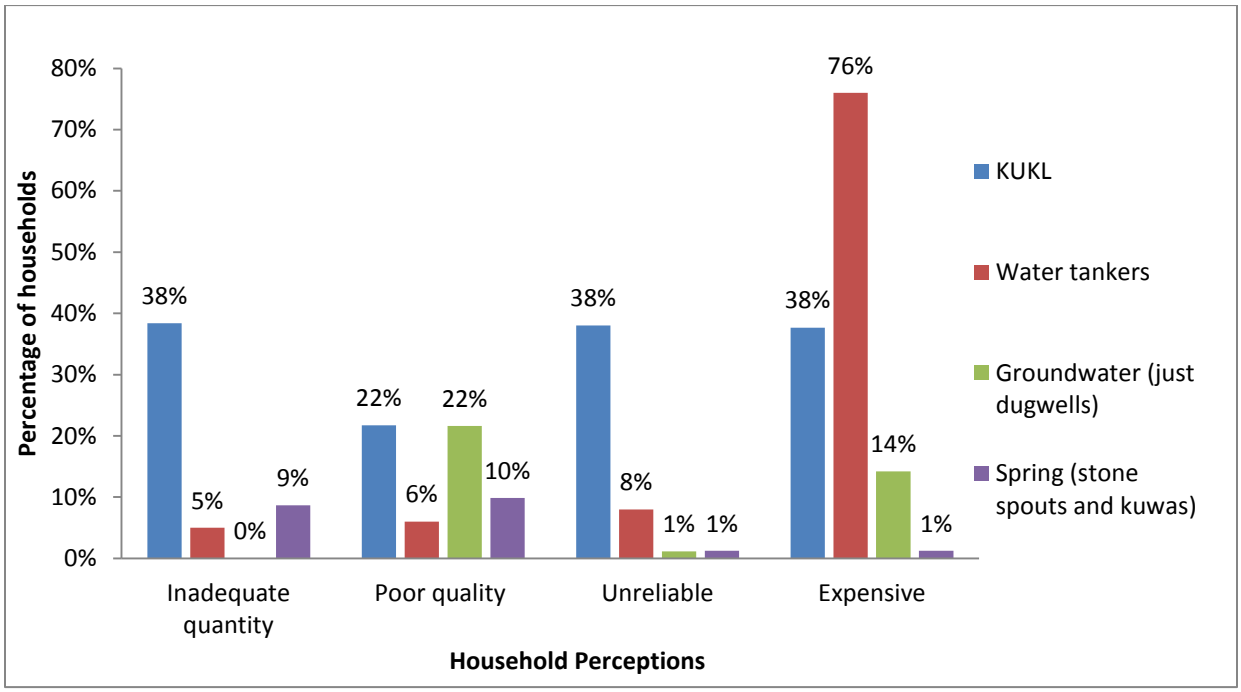
Unlike stone spouts, open springs (kuwas) were only used by 4% of the household surveyed. These kuwas are used primarily in the rural VDCs than the sub-metropolitan city where the average distance of travel is 570 m and with a travel time of 16 minutes. Households are reported to depend on only one kuwa and are use daily by 50% of the respondents in the rural VDCS. Similar to the stone spouts, the kuwas dependent on flowed both in the wet and dry seasons.

Primary difficulties regarding dhunge dharas	# of responses	**Suggestions regarding improvement of dhunge dharas**	# of responses
Expensive	1	Collect water in tank and deliver at home;	23
Not enough water	5	Keep the surrounding clean;	27
Inconvenient	4	Timely delivery;	0
Reliability	3	Implement rules for water collection;	4
Poor quality	8	None	14
Low pressure	1		
No storage	1		
Frequent strikes	0		
No one to fetch water	4		
No electricity	0		

Any other	11	
No difficulty	29	

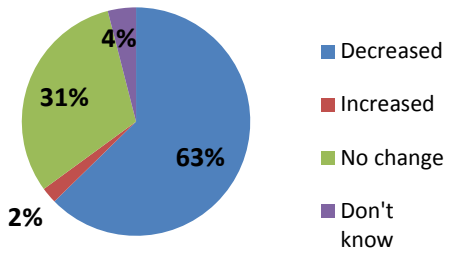
Comparing Sources Across Quanity and Quality Problems

The graph below shows the overall comparison of each of the water sources in regards to the respondent's perception of a water source's insufficiency, poor quality, unreliability and high cost. When it comes to quantity, 38% of the respondents perceive KUKL to be the most inadequate source of water. This can be explained by a households' expectation of KUKL to be able to sufficiently meet their water needs. In the area of poor quality, water from KUKL and dug well sources are seen by households to be of poor quality in comparison to the other sources. When it comes to reliability, households popularly cite KUKL as the most unreliable source of water. And lastly, purchasing water from the water tankers is seen to be the most expensive alternative water source.



Households and their Perception of the Quantity of Water Available

When the respondents were asked to compare the quantity of water they availed from all the water sources they had from 5 years ago, more than half of them (63%) responded that there was a decrease of water available while a third did not notice any change in available water. Coping strategies popularly employed by households are reported to be buying water, utilizing alternative water sources and storing water.

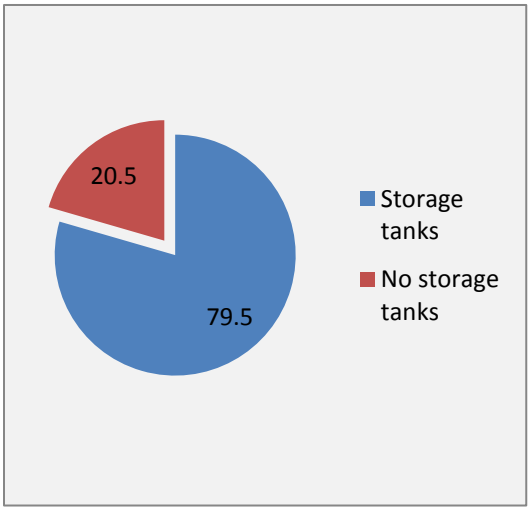


Coping strategy to deal with decrease in water quantity	
	# of household responses
Use motor to lift tap water	8
Efficient water use	41
Store water	51
Buy water	73
Depend on multiple sources	66
Use Rain and waste water	11

Water Storage Tanks as a Coping Mechanism for Water Shortage

The details regarding the reservoir tanks used by households as a form of coping strategy were also gathered during the survey. It was found the 80% of households do have water storage systems, both the urban and rural VDCs alike. The survey showed an existence of 531 storage tanks which is equivalent to around 2 tanks per households who reported to have water tanks. Among the types of water tanks, more than half of the households use rooftop tanks (56%) and these tanks had an average capacity of around 1000 liters. On the other hand, underground tanks are found to be of higher capacity of 6000 liters. Of the 279 households surveyed, around 26% installed one of their tanks in the past 5 years.

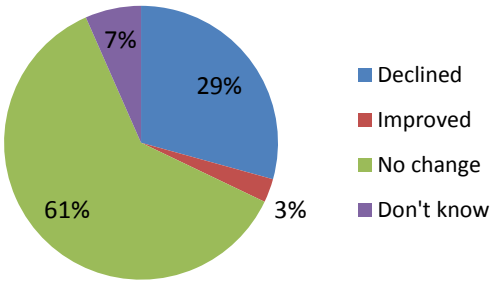
Details of reservoir tanks			
	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total
# of respondents who have reservoir tanks	185 (80)	94 (78)	279 (79.5)
Total # of underground tanks	102	39	141 (27)
Total # of rooftop tanks	191	108	299 (56)
Total # of on-ground tanks	58	33	91 (17)
Avg. capacity of underground tanks (L)	5973.9	6080	6002.1



Avg. capacity of rooftop tanks (L)	1017	1125.3	1052.6
Avg. capacity on-ground tanks (L)	506.9	1570	792.3
# of respondents who have installed at least one of their tanks in the past 5 years	35 (15.2)	37 (30.8)	72 (25.8)

Households and their Perception of the Quality of the Water Available

On the side of water quality, only close to a third of respondents reported a water quality decrease compared to 5 years ago while 61% of respondents did not perceive any changes in water quality. When it came to the coping households currently employed in addressing poor water quality, the most popular method is filtering the water using traditional and modern ways. In terms of health, only 10% of households reported to have gotten sick due to the water they drank which can be understood due to treatments done prior to consumption. The traditional method of filtering water followed my boiling water were found to be the types of treatments employed.

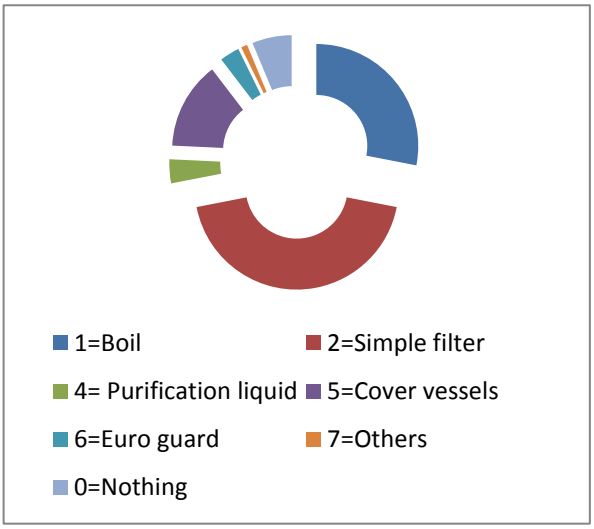


Coping strategy to deal with decline in water quality	
	# of household responses
Filter using traditional and modern ways	51
Boil	14
Treat with alum and chlorine	33
Let particles settle out	5
Drain water	5
Don't use for drinking	4
Buy water from tankers	8
Depend on other sources	2
Nothing	2

Household Sickness Incidence and the Types of Water Treatments Practiced by Households

The two most popular water treatments used by households simply filtering water and boiling the water. These methods have more than likely enabled households to combat water-borne diseases. The effectiveness of these simple techniques can be seen by the very low response by households when it comes to the question of whether or not one of their household member's got sick.

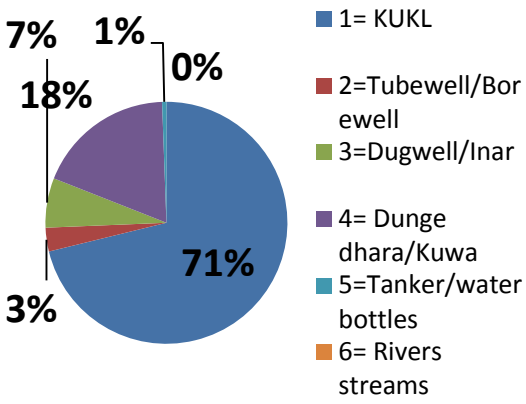
Did anyone in the household get sick due to drinking water?	Lalitpur Sub-metropolitan area	Lalitpur VDCs	Total (%)
Yes	22	14	36 (10)
No	209	106	315 (90)
Water Treatments used			
Boil	115	55	170
Simple filter	177	90	267
Purification liquid	16	7	23
Cover vessels	54	30	84
Euro guard	12	7	19
Others	3	3	6
Nothing	24	14	38



KUKL as the Preferred Drinking Water Choice Explained

When respondents were asked about which water source they preferred for consumption if they hd a choice, an overwhelming 71% of them chose KUKL. Despite its unreliability as a water source, KUKL is seen by households as easily accessible and reliable given better conditions. A properly functioning KUKL pipeline supply right at home would save time and energy in having to fetch or buy water. Households also generally see KUKL's water supply to be of good quality despite some issues at times. The second drinking water source preferred by households is dug wells (7%). Dug wells are preferred by some households due to its also good water quality, with an emphasis on its sweet taste that is not the case with KUKL's water supply.

Preferred drinking water source	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total (%)
KUKL	160	88	248 (71.1)
Tubewell/Borewell	5	7	12 (3.4)
Dugwell/Inar	18	5	23 (6.6)
Dunge dhara/Kuwa	46	18	64 (8.3)
Tanker/water bottles	2	0	2 (0.57)
Rivers streams	0	0	0



Degree of Correspondence by Authorities Regarding Household Complaints:

Other than gathering details about the various water sources in the rural VDCs and the sub-metropolitan areas, information regarding the correspondence of authorities in addressing household concerns were also gathered. Water quantity and quality problems were reported by 24% and 6% of the households respectively. Households commonly brought their issues to institutions like KUKL and their respective VDC communities. When asked about the degree of institutions addressing their complaints, it was found that 79% of reported water quantity problems and 95.2% of reported quality problems were not at all addressed. These figures suggest the importance of having institutions more responsible towards their constituents. Households were also asked about their ideas on addressing water quantity and quality problems and the suggestions dealt with topics like increasing access to a variety of water sources, better management and distribution of water by the government, lifestyle changes in water use and a more active role of the community in water issues.

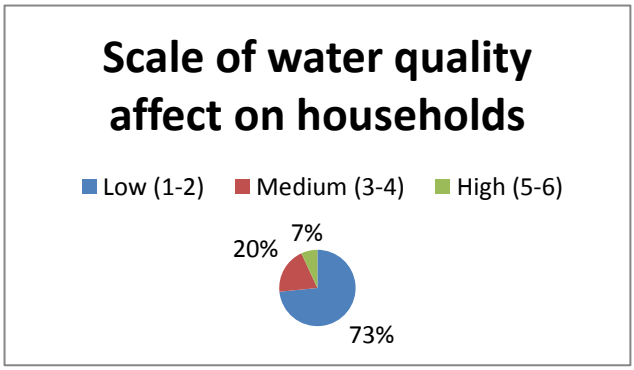
	Yes, completely solved	No, nothing happened	Yes, solved to some extent
Households who complained about water shortage? Yes: 85 (24.2) / No: 266	1	67 (78.8)	17
Households who complained about poor water quality? Yes: 21 (6) / No: 330	0	20 (95.2)	1

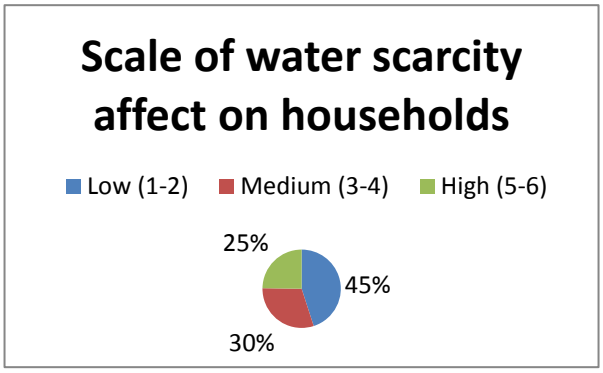
The Level of Effect of Water Scarcity and Quality Issues to Households

An overall evaluation of the water scarcity and poor water quality felt by households was also measured in this survey. From a scale of 1 to 6, with "1" representing very low to "6" representing very high, households rated how they were affected. The CHARTS below demonstrate that there is a general "low" effect on households in regards to both water quantity and quality problems. Around 73% of households and 45% of households experience a low effect from water quantity and quality concerns, respectively.

The effects of water shortage on households were also shown to be more pressing than water quality issues as seen by 25% of households highly affected by the shortage to only 7% of households being highly affected with water quality concerns.

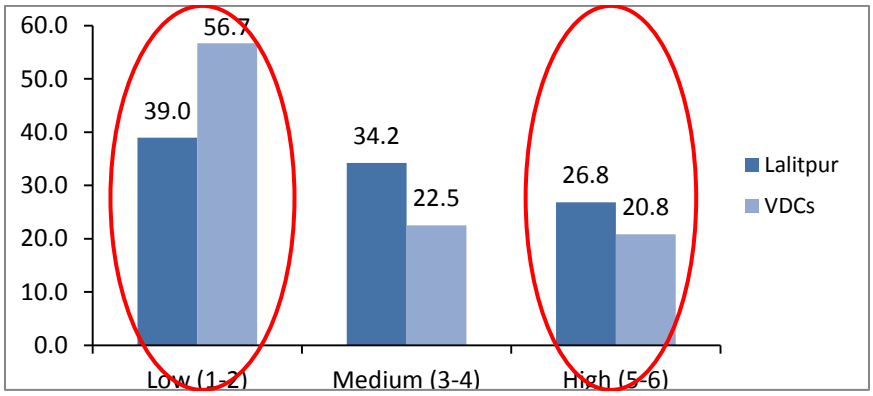
How affected is your household by water quantity and quality problems?			
Scale	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total
QUANTITY Scale			
1	26	30	56 (16)
2	64	38	102 (29.1)
3	22	4	26 (7.4)
4	57	23	80 (22.8)
5	26	14	40 (11.4)
6	36	11	47 (13.4)
QUALITY Scale			
1	81	40	121 (34.5)
2	99	38	137 (39)
3	19	7	26 (7.4)
4	19	24	43 (12.3)
5	8	8	16 (4.6)
6	5	3	8 (2.3)



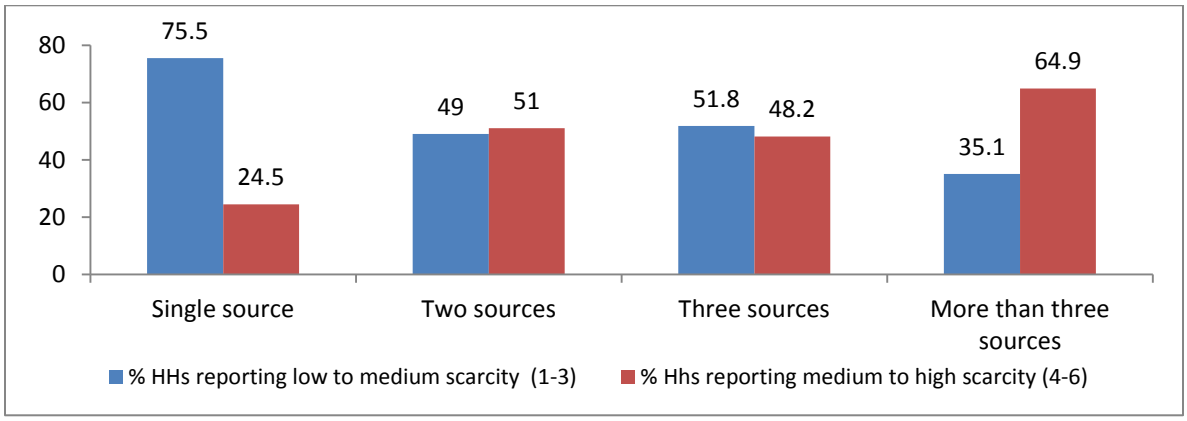


POSSIBLE DETERMINANTS TO WATER SCARCITY:

Urban areas are more susceptible to water scarcity issues.
In comparing urban areas and rural VDCs, the water scarcity perception is much higher in the urban areas than in the rural VDCs. This suggests an imbalance of meeting household water needs between rural VDCs and the urban areas.

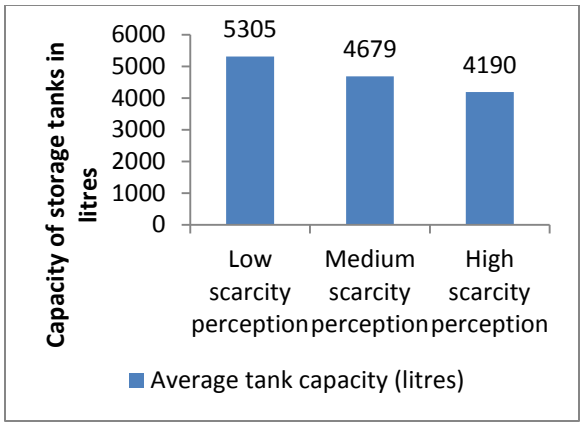


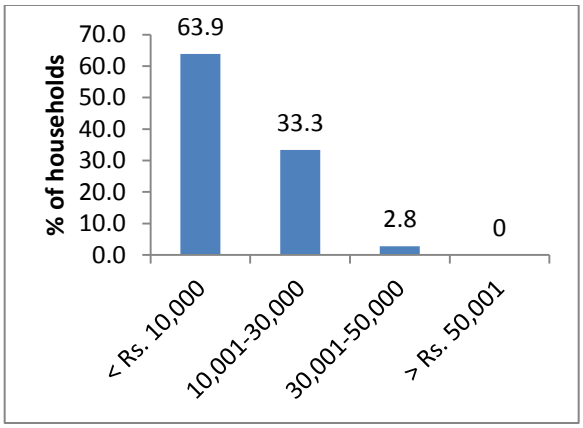
Dependence on more number of sources does not lower scarcity perception.
Contrary to common belief, the more sources of water do not necessarily correlate to low scarcity perception. Interestingly, households who experience higher water scarcity tend to depend on multiple sources as a coping strategy.



High water storage capacity is inversely related to water scarcity perception.

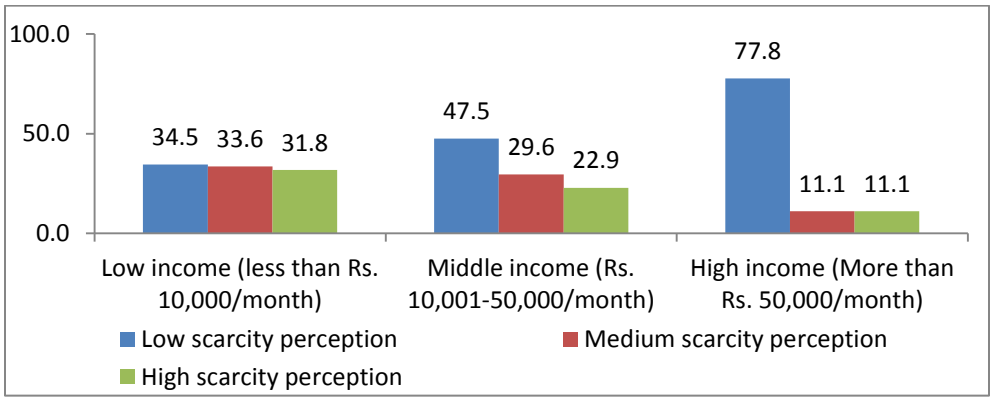
Data gathered from the survey showed that 80% of households have water storage systems to help cope with water shortage. Further analysis of these water storages showed an interesting inverse relation between perceived water scarcity and the capacity of the water storage systems. It was found that the higher water capacity, the lower water scarcity perception. However, majority of those who don't have storage tanks belong to the lowest income.



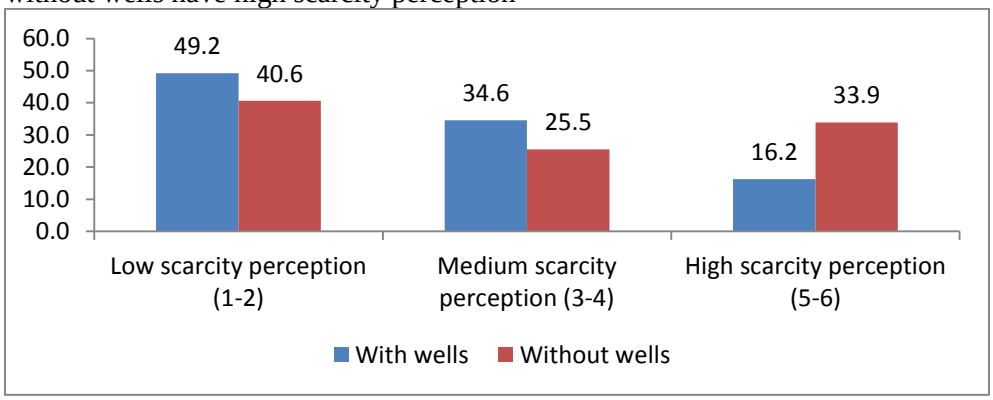


Households with higher income and with access to groundwater have lower water scarcity perception

Three-fourths of HHs with highest level of income had low water scarcity perception.



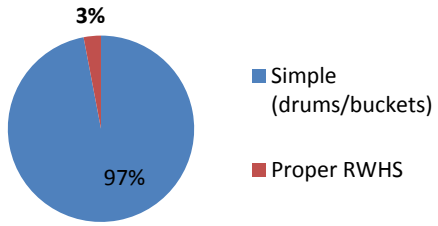
50% of HHs with access to groundwater has low water scarcity perception, while 1/3 of households without wells have high scarcity perception

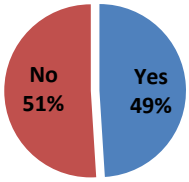


RAINWATER HARVESTING

The Current Status of Rainwater Harvesting in Lalitpur

Understanding of the current state of rainwater harvesting and people's perceptions to this water conservation tactic were also evaluated during the survey. Overall, close to half of the respondents (4%)) are harvesting rainwater. Almost all of the households (97%) practice conventional rainwater harvesting using drums and buckets while only 3% have a proper rooftop rainwater harvesting structure with a dedicated tank.





Popular uses for harvested rainwater include washing clothes, using the water for toilet and bath and cleaning the house and cars and bikes. A primary reason given by households for not investing in any kind of rainwater harvesting is their perception that they had "enough water". This perception is likely caused by the time frame that this survey was conducted, which was during the monsoon season The reasons cited by households for not investing in a proper rainwater harvesting structure include improper rooftop structure, the high investment cost and no space for tanks and pipes. The good news is that households would be more encouraged to invest in this type of structure if they had their own house, a proper rooftop and enough space for the tank. The perception on their being a water scarcity would also encourage them too.

	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total
Details on rainwater harvesting			
# Harvesting rainwater	117	55	172 (49%)
# with simple RWH	112	54	166 (97%)
# with rooftop structure with dedicated tank	5	1	6 (3%)
Average number of years doing RWH?	6.7	7.3	6.9

	Main uses of RWH water				**Reasons for not investing in RWH with dedicated tanks**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total

Washing clothes	104	45	149	Technology constraint	20	15	35
Cleaning house and cars/bikes	54	23	77	Rooftop not suitable	19	11	30
Toilet and bath	70	29	99	Expensive	24	15	39
Gardening	11	6	17	No space for tanks and pipes	28	2	30
Livestock	0	4	4	Poor quality	3	2	5
Drinking	2	1	3	Constructing a RWH structure	1	2	3
				On rent	12	4	16
				Enough water	14	7	21
	Reasons for not practicing RWH of any kind				**What would encourage you to invest in proper RWH with tanks**		
	Lalitpur Sub-metropolitan	Rural VDCs	Total		Lalitpur Sub-metropolitan	Rural VDCs	Total
Enough water	61	43	104	Water scarcity	58	47	105
Rooftop not suitable	12	4	16	Financial support from government	49	22	71
Technology constraint	23	20	43	Own house, proper rooftop, adequate space;	90	25	115
Expensive	1	0	1	4=Technological support;	53	23	76
Not reliable	3	2	5	Others adopt;	1	4	5
Poor quality	6	2	8	Not interested at all	13	7	20
No space for tanks and pipes	10	4	14	Already invested	5	1	6
Not interested	5	2	7				

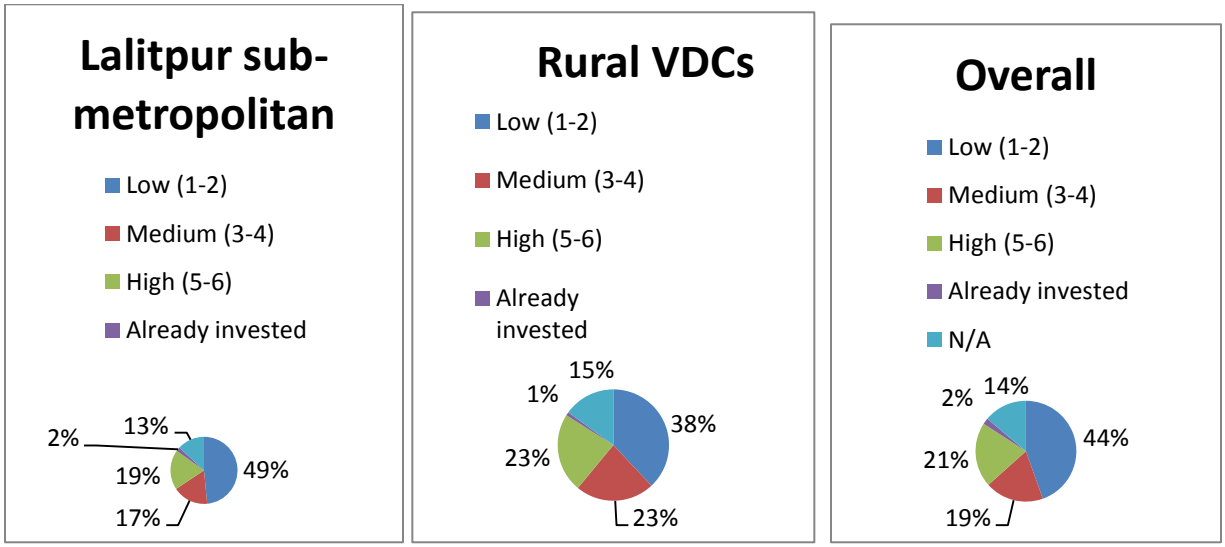
Details About Simple vs. Proper Rainwater Harvesting

Households who practice simple rainwater harvesting report to collect around 240 liters of rainwater. Rainwater is harvested during the monsoon season and once it is collected, it is often used right away. This one time use and collect allows rainwater to be used only during the 3-4 months in the year (monsoon season). The investment cost of this type of system is usually nothing since existing pans and

buckets are used; however, the households who did invest in bigger storage units (200-7000 liters) spent around 1433 rupies.
Rooftop rainwater harvesting with a dedicated tank is seen to be more prominent in the Lalitpur sub-metropolitan area than in the rural VDCs (ratio of 5 to 1). The dedicated tanks in these households collect rainwater anywhere from 1000 to 7000 liters. Households who have a 1000 L tank reported an investment anywhere from 25,000 to 45,000 rupies for the proper structure.

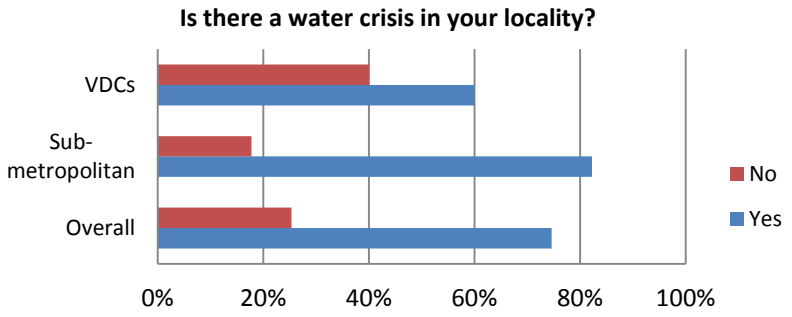
Household Interest and the Future of Rainwater Harvesting

Below are the charts that show the interest levels of households when it comes to investing in rooftop rainwater harvesting with a dedicated tank. A scale of 1 to 6 with 1 being very low and 6 being very high was used to chart a household's interest level. Overall, households have a low interest level (44%) of investing in proper rainwater harvesting structures. This low interest level is also seen to be higher in the urban area than the VDCs.



<u>Overall, households perceive some form of water crisis/problem in their locality</u>

Towards the end of the survey, households were then asked about their thoughts on whether or not their locality is suffering from the water crisis and the degrees to which their total household water needs were met. The survey shows that a significant number of households in both rural VDCs and urban areas do perceive some form of a water crisis. This water crisis perception was also shown to be 12% higher in the urban area compared to the rural VDCs. The percentages also show that the urban areas feel the water crisis the most. And in the case of rural VDCs, a table was also made to show the breakdown of the water crisis perception and it shows that areas such as Dhapakhel and Imadol show a significant degree of water crisis felt by the households surveyed. Now of course, further research involving a much larger sample size still needs to be done in order to validate these perceptions. In the area of the ability of the various types of water collected to fill a household's water need, 42% of households replied that their needs were "usually met".



Perception on adequacy of water after all available water sources have been used			
	Lalitpur Sub- Metropolitan Area	VDCs in Lalitpur	Total
Always met	43	35	78
Usually met	99	47	146
Occasionally met	54	24	78
Rarely met	30	13	43
5=Never met	5	1	6

Respondents were also asked regarding their views of the groundwater. It was found that around two-thirds of households in the urban areas (65%) have a high dependence on groundwater while more than half of the households in the rural VDCs have no dependence on groundwater (53%). And when it comes to the concern regarding the state of groundwater depletion, there was a low concern seen in both the rural VDCs and urban households.

	Dependence on groundwater			**Concern about groundwater depletion**		
Rating	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total	Lalitpur Sub-Metropolitan Area	VDCs in Lalitpur	Total
0	62	64 (53)	126 (36)	-	-	-
Low (1-2)	5	3	8	106 (46)	77 (64)	183 (52)
Medium (3-4)	14	8	22	54	16	70
High (5-6)	150 (65)	45	195 (56)	71	27	98

State of management of water sources

According to household perceptions, water supply is currently being managed by the government or their municipality. A few had also stated the community as one of the managers. And when it comes to who should manage the water supply, the majority of households still put their trust in the government or their municipality.

	Who currently manages water supply (responses)	**Who should manage water supply** (responses)
Community	104	62
Private sector	31	27
NGOs	0	3
Government/Municipality	225	240
Self	72	5
I don't know	39	23

Part II: How My Research Tackles Food Insecurity

My research about the groundwater use, water quality and quantity issues through the eyes of the households themselves tackles the topic of food insecurity by displaying the struggle people go through to obtain the basic of things- clean and safe water. This struggle to meet water needs is an economic burden to the majority of Kathmandu Valley's citizens, especially the urban and rural poor who do not have enough money to invest in wells or purchase tanker water. Households in Kathmandu Valley do not only worry about filling their stomachs but also their thirst. Based on my research, considerable time, money and effort are being spent by these households to meet their water needs. One can only imagine how these households are going about in prioritizing their agenda for the day- get water or food? Households would most likely choose food over water in this case; a choice that often compromises individual health as unsanitary water is used for drinking and bathing.

In order to ensure food security, water needs to be both available and usable to people. Water is essential to the health of individuals as it forms the backbone of everything that we do to function properly right from the simple task of brushing one's teeth to irrigating agricultural land. As Dr. Daniel Hillel mentioned during one of his lunch talks at the 2012 World Food Prize convention, water is what made ancient civilizations thrive and once problems occurred regarding water, they crumbled.

In this fast-paced and technology-driven world, it is very easy to lose track of properly managing our most essential resources for life- food and water. We have exploited our natural resources beyond their ability to properly replenish and repair themselves. And the worst part of it, the poor and unfortunate individuals of society are always the ones heavily burdened even when they

took little part in the escalation of the problem. That to me is unjust and is primary reason why I feel that the well-off individuals of a society or countries in the world have a duty to fill towards combating food insecurity.

Part III: Personal Journey

Culture and Travels

My first night away from home. The reality of being half-way across the globe did not hit me right away. For the first few days, I thought I was dreaming. The reality of me being away from home sunk in only after frequent conversations with the residents of my guesthouse, shopping at markets, walking around the neighborhood and eating at local restaurants. It was an adjustment process that took a few days, and once my internship officially started, the fact that I was in Nepal was solidified in my mind. I was ready to meet Aditi and do work.

My experience as the youngest intern at ICIMOD. I was fortunate enough to have such friendly and accommodating people around me. They were not close my age but the camaraderie I felt made me feel comfortable in ICIMOD. Aditi had also provided me with my own workspace which I thought was very nice of her and made me feel "official". During my research study at ICIMOD, I was glad to have been given a team of research assistants: Manzari, Nabina and Mira, to help conduct my surveys and data entries. They were close to my age and we all bonded through long weeks of hard work.

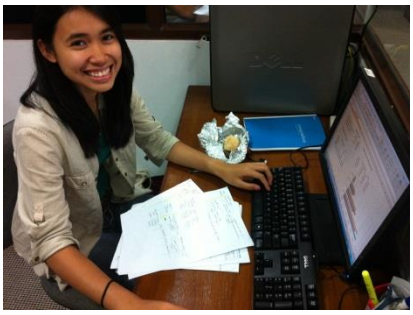
As for cultural attractions, I was able to visit the three famous Durbar Squares ("King's Palace") during my 2 months in Nepal. I visited Kathmandu, Bhaktapur and Patan Durbar Square, all of which were rich with history and craftsmanship. What amazed with each of these places are the intricate stone and wood working of both religious figures and various structures. What also caught my attention in these areas are the traditional stone spouts that were constructed centuries but were still functioning. This water source was actually one of the components of my research.

Reflection

If I were to sum up my internship experience in one sentence, I would say that it was a huge learning experience. Spending 2 months in Nepal taught me a whole lot about what field research is about. Prior to my internship, I had no background in conducting surveys or experience in Excel other than making simple charts and graphs. After my internship, I personally understood the amount of work and time it takes to conduct household surveys and the interesting stories that accompany it. I also gained valuable skills when it came to working with Excel and how to properly handle a large amount of data. My summer experience also taught me the values of paying careful attention and proper communication with the people I worked with. It was this summer that I fully realized that I was no longer a "high school kid", but an adult, an adult that will be tasked with responsibilities and be held accountable to them. It was an internship experience that also made me aware of the scope of problems out there and the difficulty of coming up and implementing solutions. However, interacting with different households and recording their perceptions regarding the water quantity and quality issues in Nepal solidified in

me the importance of keeping an optimistic outlook and need to take necessary action. I have been blessed with a high level of comfort and security that comes with living in a prosperous nation, the least I could do in this world is also make it achievable to people who are not lucky as I am. Tackling food insecurity is a long and demanding task, but the rewards of it come in knowing that I can make someone's life a little better by giving them good and clean access to drinking water and enough food to sustain them every day.

Pictures



References

ADB. (2003). Kathmandu Valley Water Supply Services Development Program. Asian Development Bank (ADB), Philippines.

Diwakar, J., Yami K. D., & Prasai, T. (2008). Assessment of Drinking Water of Bhaktapur Municipality Area in Pre-monsoon Season. *Scientific World* 6(6), 94-98.

Dixit, A., & Upadhya, M. (2005). Augmenting Groundwater in Kathmandu Valley: Challenges and possibilities. Retrieved from http://r4d.dfid.gov.uk/pdf/outputs/water/r8169-nepalpaperjan05final.pdf

Dongol, R. (2012). Overview of Water Markets in Kathmandu Valley. In: Shrestha S., Pradhananga D., Pandey V.P. (Eds.) *Kathmandu Valley Groundwater Outlook.* Asian Institute of Technology (AIT), The Small Earth Nepal (SEN), Center of Research for Environment Energy and Water (CREEW), International Research Center for River Basin Environment-University of Yamanashi (ICRE-UY). pp 21-30.

The Himalayan News Service. (2013, July 04). Trap the Rain!. *The Himalayan Times.* Retrieved from http://www.thehimalayantimes.com

Jha, P.K. and Shrestha, K.K. 2013. Climate Change and Urban Water Supply: Adaptive Capacity of Local Government in Kathmandu City, Nepal. *Journal of Forest and Livelihood,*11(1): 62-81.

JICA (1990) Groundwater management in Kathmandu Valley, Final Report, Executive summary, p 2. Kathamandu: JICA.

Pandey V.P., Chapagain S.K., Kazama F. (2010). Evaluation of groundwater environment of Kathmandu Valley. Environmental Earth Sciences 60(6), 1329-1342.

Pandey, V. P., Shrestha, S. & Kazama, F. (2012). Groundwater in the Kathmandu Valley: Development Dynamics, Consequences and Prospects for Sustainable Management. *European Water* 37, 3-14.

Prasai, T., Lekhak, B., Joshi, D. R., & Baral, M. P. (2007). Microbiological Analysis of Drinking Water of Kathmandu Valley. *Scientific World* 5(5), 112-114.

Sagara, J. (2000). *Study of Filtration for Point-of-use Drinking Water Treatment in Nepal* (Doctoral dissertation). Retrieved from http://web.mit.edu/watsan/Docs/Student%20Theses/Nepal/Sagara2000.pdf

Sharma, N. (2011). 700ml Illegal Groundwater Extraction Daily. *The Kathmandu Post.* Retrieved from http://www.ekantipur.com/the-kathmandu-post/2011/12/20/metro/700m-l-illegal-groundwater-extraction-daily/229508.html

Shrestha, R. R. (2009). Rainwater Harvesting and Groundwater Recharge for Water Storage in Kathmandu Valley. Sustainable Mountain Development No. 56, International Centre for Integrated Mountain Development. Retrieved from http://books.icimod.org/uploads/tmp/icimod-water_storage.pdf

Subedi, M. & Aryal, M. (2010). Public Perception about Drinking Jar Water and its Bacteriological Analysis. *Nepal Med Coll J* 12(2), 110-114.

Warner, N. R., Levy, J., Harpp, K. & Farruggia, F. (2008). Drinking Water Quality in Nepal's Kathmandu Valley: A survey and Assessment of Selected Controlling Site Characteristics. *Hydrogeology Journal* 16, 321-324.

Yoden, K. (2012). Analysis of Domestic Water Use in the Kathmandu Valley. In: Shrestha S., Pradhananga D., Pandey V.P. (Eds.) *Kathmandu Valley Groundwater Outlook*. Asian Institute of Technology (AIT), The Small Earth Nepal (SEN), Center of Research for Environment Energy and Water (CREEW), International Research Center for River Basin Environment-University of Yamanashi (ICRE-UY). pp 21-30.

Yoden K, Chettry L. (2010). Kathmandu Valley Water Distribution, Sewerage and Urban Development Project: PPIAF- supported Baseline Survey Part I. Submitted to Asian Development Bank, Philippines.