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Estimating the Burden of Diarrheal Disease caused by Water and Sanitation

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Research Report

Estimating the Burden of Diarrheal Disease caused by Water and Sanitation

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Dr. Chop Lal Bhusal

Executive Chairman

ACRONYMS

BoD	:	Burden of Diseases
DALY	:	Disability Adjusted Life Years
DoHS	:	Department of Health Services
DW	:	Disability Weighted
EBD	:	Environment Burden of Disease
ENPHO	:	Environment and Public Health Organization
GBD	:	Global Burden of Disease
GoN	:	Government of Nepal
HH	:	Household
NGO	:	Non Governmental Organization
NHRC	:	Nepal Health Research Council
PhD	:	Doctor of Philosophy
RR	:	Relative Risk
SLC	:	School Leaving Certificate
SODIS	:	Solar Water Disinfection
WASH	:	Water Hygiene and Sanitation
WHO	:	World Health Organization
YLL	:	Years of life Lost
YLD	:	Years of life lived with disability

EXECUTIVE SUMMARY

There is direct relationship between human being, environment and health. The magnitude of health problem is increasing day by day due to various environmental risk factors. Diarrhea is the major health problem in most of the developing countries, and a major significant environment sensitive disease. It is estimated that about 94% of the diarrheal burden is attributable to environment, and is associated with risk factors such as unsafe drinking water, poor sanitation and hygiene. The purpose of this current study is to estimate and calculate scenario based diarrheal diseases burden related to water sanitation and hygiene. This was a cross sectional, descriptive and comparative study in which 360 households were selected from six different scenarios on the basis of water sources and availability of toilet from terai, hill and mountain regions. This study could not represent all geographical and ethnic community because it is conducted within limited district and small scale. The findings of the study are explained on the basis of different scenario.

Out of the total diarrheal cases of 132 in the entire scenario the highest proportion is seen high (25%) in scenario spring without toilet, and the lowest (9%) is seen in scenario tap water with toilet. Mean number of days suffered from diarrheal disease and no of episodes was high with scenario having spring water without toilet viz. 7.61 days and 2.03 respectively, and lowest diarrheal episodes was found in scenario having tap water with toilet (1.23). Hygiene and sanitation practice of the community people was found good in all the scenario with more than 90 per cent responding that they wash hand after defecation and before eating food. Most of the people do not make any treatment of water for drinking purpose, only very few percentage of respondents said that they treat water at household before consumption. Years lived with disability was found to be highest, 18.10 per hundred thousand in the scenario spring water without toilet, and least value of YLD was computed 2.39 in the situation of tap water with toilet facility available. Premature Mortality (YLLs) was not revealed in study sample from the selected communities. While the odds of risk of acquiring diarrheal disease for the scenario (spring without toilet) was nearly four times higher than the reference scenario- tap water with toilet facility which was statistically significant as well.

Thus, disease burden and risk of the disease is seen high among those people who don't have toilet and consume water from spring or tube well. Appropriate awareness program targeted to high diarrheal disease burden areas should be conducted henceforth to cut short the diarrheal disease transmission and prevent the risk of acquiring it.

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CHAPTER I INTRODUCTION

1.1 Background

An estimated 24% of the global disease burden and 23% of all deaths can be attributed to environmental factors. In particular, an estimated 94% of the diarrheal burden of disease is attributable to environment, and is associated with risk factors such as unsafe drinking water and poor sanitation and hygiene (WHO, 2008). And unsafe water and poor sanitation is major contributing factor for causing diarrhea. The fraction of the total burden of diseases worldwide- around 10% - could be prevented by improvements related to drinking water, sanitation, and hygiene and water resource management (WHO, 2008).

Diarrheal diseases are one of the major infectious diseases in the world accounting about 1.5 million under 5 deaths annually. It is one of the leading causes of morbidity and mortality in developing countries. In 2004, diarrheal disease was the third leading cause of death in low-income countries, causing 6.9% of deaths overall. Globally, around 1 billion people lack access to improved water and 2.5 billion have no access to basic sanitation. Diarrhoea occurs world-wide and causes 4% of all deaths and 5% of health loss to disability.

Most importantly, the disease spread from unsafe drinking water, poor sanitation and personal hygiene, through faeco-oral route. A number of diarrheal outbreaks occur due to water and hygiene related problems and the infection is widespread throughout developing countries each year. Water related diseases are emerging subsequently either due to they are newly recognized or due to the evolving micro-organisms in the changing pattern of managing the water resources and supplies or due to change in human population itself.

Most of the water supply systems in Nepal both in urban and rural don't have basic water treatment facilities. This has resulted in to frequent reports of faecal contamination in drinking water and outbreaks of waterborne diseases, particularly in monsoon. The government, concerned authorities and stakeholders should take this as a warning bell and show serious concern to take precautionary steps for mitigation and control measures through effective collaboration and coordination among WASH sector stakeholders. Though diarrhea is a

preventable disease but the intervention targeted should be enforced keeping in mind that prevention is better than cure. (Maharjan, 2010)

The assessment of disease burden attributable to diarrheal disease may be scenario based approach. Six different scenarios is identified for this study to assess the diarrheal disease burden viz Tap water with toilet, Tap water without toilet, Spring with toilet, Spring without toilet, Tube well with toilet and Tube well without toilet. The scenario was mapped according to the source of water and availability of toilet facilities and the difference in the disease pattern from one scenario to other has been tried to calculate. The assumption is bacterial contamination in water varies with different situation such as source variation of water supplies, variations of sanitation situation across the study population, location variation of water supplies, variations of sanitation situation across the study population. For instance, such exposure scenarios would be divided based on the population categories depending on different water sources namely, households with access of piped water supplies and households with other sources such as well, stone spout, river etc. The study is further based on the principle that the health outcomes of the pre-identified exposure scenarios can be obtained from cross-sectional survey of the study population or from the previous studies conducted for the study area.

1.2 Rationale of the Study

Diarrheal disease is one of the major health problems of under five children and it is not only limited to under five children but also has the similar burden in other age groups. The prevalence of diarrheal diseases depends on various factors such as hygiene and sanitation practice including the quality and quantity of water. It also depends on settlement of community people in different geography. Furthermore educational status, cultural practices and other socio-cultural environment also play an equally important role.

The study on burden of disease can demonstrate the feasibility of quantifying the contribution of disease, injuries and risk factor to population health said (Mathers, CD., et.al., 2001) The goal is that measurement will lead to a healthier world. The measurement could be used to guide public policy to change the future burden of disease and to give more people longer and healthier lives. Community based disease prevalence or scenario based disease burden has not been quantified till now in the context of Nepal, though it is a challenging work due to a number of

environmental factors and insufficient resources for conducting large scale research work. And such types of research procedure are insignificant in numbers that can help to the implementer for implementing the intervention project. This type of study may be helpful for calculating the district wise disease burden caused by inadequate water and sanitation status.

1.3 Objectives

1.3.1 General Objective

To estimate burden of disease (diarrhea) of range of water intervention in Nepalese context

1.3.2 Specific Objective

To calculate the burden of diarrheal disease in different water sanitation scenario

To calculate BoD and develop as a case study for further study

To develop process for district wise calculation for BoD caused by inadequate water sanitation

1.4 Study Variables

Dependent Variable – Burden of Disease

Independent Variables

Socio-demographic Variables

Age

Sex

Family Type

Religion

Occupation

Educational Status

Economic Status

Disease related Variables

Diarrheal Disease

Incidence of Diarrheal Disease

Burden of Disease

Water and Sanitation related Variables

Water treatment behavior

Food consumption pattern

Type of water source

Type of toilet

Hand washing practice

1.4.1 Operational Definition

Burden of Disease: Burden of diarrheal disease calculated in terms of disability and mortality caused by diarrhea.

Type of water source The source of water was categorized as below

Tap Water: Water distributed from district water supply office or any other source in the form of piped distribution.

Tube Well: Source of water where water is extracted from underground using a hand pump.

Spring Water: Natural water of spring/canal/well/stone spout/river/others or from any impounding reservoir. Water coming from high hills and mountain regions recognized as "*Mul ko pani*"

CHAPTER II LITERATURE REVIEW

There is a direct relationship between human being, environment and health. Environmental health comprises those aspects of human health, including quality of life that is determined by physical, social and psychological factors in the environment (WHO 1993).

Type of latrine facility is also reported important determining factor to determine the rate of bacterial infection. The infection rate of Shigellosis dysenteriae 1 and Shigellosis flexneri has reported highest and persistent at non septic tank than that of septic tank. And both types of incidence were highest in children under 2 followed by children above 2 to 5. (Emch, M., et al., 2008).

Hospital based cases of diarrhea and parasitoids were reported and analyzed from four public health center of salta city province, north Argentina during year 2005. Diarrhea cases showed seasonality, with the highest incidence during late spring and summer and poor sanitation area and lack of water quality (Aramayo et al., 2009).

Several factors have been reported to mediate housing and health relations, including psychosocial, environmental, socioeconomic, behavior-cultural, and physiological factors (Chaudhuri, et al., 2004).

A population based cross-sectional study of diarrheal prevalence was conducted on reproductive age of women (n=189) in the sahsa region of northern Nicaragua in July 2009. The use of water purification methods, such as chlorine and filters, and latrine ownership were not associated with reduced prevalence of household diarrhea in the two week reporting period. Latrine overflow, however, was associated with an increased prevalence of diarrhea during the same two week period (Denslow., et al., 2009).

The findings of a study conducted on two situations at households fully exposed to contaminated drinking water and households receiving water quality intervention revealed the best practice on reducing and eliminating diarrheal disease through integrated control strategies (Eisenberg, et al., 2007).

A research work revealed unsatisfactory quality of stone spouts and had shown positive test result in coli form test. About 90% of samples showed excess ammonia concentration, 60% samples showed excess nitrate concentration and excess phosphate concentration and 50% of samples was found to be above WHO permissible value. (NGO Forum for Urban Water and Sanitation, 2008)

In Nepal, about 39% of total rural households have access to piped water compared with 68% in urban areas. Access to piped water is lowest in Terai, 75% of Terai households have access to covered wells (tube well), whereas 62% of the households in the Mountain have access to piped water outside the house (Community tap). Rivers, streams, ponds are also another important source of water for the rural people. Water thus collected is used directly in many circumstances without any treatment, which is highly loaded with fecal contaminants.

Environment and Public Health Organization (ENPHO) in 2000 revealed the need for a comprehensive study on arsenic contamination in tube well water to find out the extent of arsenic distribution in southern Nepal. Since then, governmental and non-governmental organizations and some researchers have tested several thousand samples of tube well water to identify levels of arsenic contamination and have found that 7.4% of tubewells had arsenic concentrations more than the maximum permissible limit (50 μg/L) for Nepal (Shrestha et al., 2004).

A study was conducted on Urban Water Quality in Nepal at Seventeen Municipality by Environmental Public Health Organization (ENPHO) at Source, Reservoir and Tap. This study disclosed that fecal contamination was major risk in supply system of drinking water rather than physiochemical contaminant (ENPHO, 2003).

Shallow tube wells are the major water supply modes in most of the Terai towns, in Nepal. Information about the quality of such water is very limited. Some sporadic studies and studies for Arsenic assessment have shown that some of these tube wells are contaminated with arsenic, many samples contained with high ammonia level, iron level and the fecal coli form contamination is rampant (SEAM-N 2005).

Annual reports of DoHS, GoN shows the three-year trend of reported diarrhoeal incidence per 1,000 under-five children. At the national level during FY 2064/65, incidence of diarrhea has found to be increased significantly (378 per 1,000) compared to FY 2062/63 and 2063/64. At

regional level also diarrhoeal incidence has increased significantly in all regions in FY 2064/65 in comparison to FY 2062/63 and 2063/64. This may be either due to increasing case detection rate or due to poor quality of drinking water (DoHS 2064).

Relative Risk: World Health organization assessment series provide an introduction to the environmental factors that pose a risk to health. The outlined general methods are used to estimate the disease burden of these factors. The first published WHO GBD concept constituted the comprehensive set of estimates on mortality and morbidity. A research team of WHO published article" Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level' based on the literature review. The team has been ascribed a relative risk (RR) value of 1.0 for ideal situation. To illustrate the major differences between scenarios II and I, in scenario II the pathogen load is mostly transferred from land to water, with insufficiently treated sewage being discharged to surface waters or potentially contaminating drinking water. In scenario I, the "ideal" scenario, this would not occur. Literatures show that WHO has calculated RRs between scenarios. For the risk transition between scenarios I and II (ideal situation to regulated water supply), about 35% of intestinal illness in the United States is food borne. After deducting the portion of food-borne transmission, and accounting for likely ratios of person-to-person transmission through aerosols of certain viruses (estimated as up to 25% for rotavirus and astrovirus), the remaining fraction attributable to water, sanitation, and hygiene is about 60% reduction. A 60% reduction in disease corresponds to an RR of 2.5 [RR = 1/(1 – reduction)] for scenario II when compared with scenario I (i.e., the "ideal"). Relative risk for other scenario has estimated from various global intervention studies, using diarrheal burden reduction principle, mentioned in the given table.

RRs associated with scenarios.

Approach	Scenario						
	I	II	III	IV	Va	Vb	VI
Minimal	1	2.5	2.5	3.8	3.8	4.9	6.1
Maximum	1	2.5	4.5	6.9	6.9	8.7	11.0

(Prüss, A., et al., 2002)

A research work conducted on Environmental burden of diarrheal disease has revealed that the relative risk of diarrheal burden varies according to exposure scenarios of unsafe water and water supply. Diarrheal deaths were more recorded on tap water without toilet facility and lowest on tube well with toilet facility. In this study risk factor was categorized into six situations providing operational definition. Six scenarios were tube well with toilet facility-1, tube well without toilet facility-2, tap water with toilet facility-3, tap water without toilet facility-4, well/spout/river/spring/others with toilet facility-5, well/spout/river/spring/others without toilet facility-6. Relative risk is computed for scenario 1 assuming that the scenario has the least exposure in terms of unsafe water and sanitation. Scenario 6 posed the highest threat with RR = 15.53 followed by scenario 4 with RR = 9.71, scenario 5 with RR = 5.26, scenario 2 with RR = 5.13 and scenario 3 with RR = 3.03. The estimated impact fraction is found to be 0.8457 which means that 84.6% of the diarrheal deaths can be attributed to unsafe water and sanitation (Khanal et al., 2006).

CHAPTER III METHODOLOGY

3.1 Study type

It was a cross sectional, descriptive as well as comparative study

3.2 Study Area

Four districts were selected on the basis of different water sanitation scenario as per source of drinking water and availability of toilet. Out of the four districts six different scenarios were selected including various VDCs meeting the criteria. Tube well without toilet facility and tube well with toilet facility was selected from Unwach VDC of Nawalparasi and Fulbari VDC of Chitwan district respectively. Tap water without toilet facility was selected from Kumpur, Sankosh and Gajuri VDC of Dhading district and tap water with toilet facility from Bharatpur Municipality of Chitwan district. Spring without toilet facility was selected from Orang VDC of Dolakha district. Similarly for the scenario spring with toilet facility again Kumpur, Sankosh and Gajuri VDC of Dhading district was taken. Nawalparasi and Chitwan represented Terai, Dhading Hill and Dolakha Himalayan district.

The community specific details of the situation of water and sanitation scenario are not available. However, the general scenario of the districts selected is as described below. In case of Nawalparasi district, the water supply coverage has been reported to be 33.8 percent of the population served by public tap, 8.7 percent is served by private tap, 12.3 percent by public tube-wells, 0.4 per cent by spring and 6.3 percent by dug wells, and a total of 57230 household have toilet facility. The case with Chitwan district is, 22.5 percent of the population served by public tap, 12.5 percent by private tap, 7.0 percent by public tube-wells, 50.5 per cent by private tub well, 1.0 per cent by spring and 6.3 percent by dug wells and 95455 household have toilet facility. In case of Dhading district, the water supply coverage has been reported to be 88.6 percent of the population served by public tap, 3.2 percent by private tap, and 3.2 per cent by spring and 38574 household have toilet facility. Similarly the case with Dolakha district is 91 percent of the population served by public tap, 6.4 percent by private tap, and 2.5 per cent by spring and 24555 household have toilet facility (DWSS, 2011).

3.3 Study Duration

The study duration of this research was six months

3.4 Study Population & Study Unit

All the populations of the selected household of selected communities were the study population. Individual member of the household either household head or family member was the study unit.

3.5 Sampling Technique

Non-probability (purposive method) technique was used as a method of sampling. Study sites were decided with a purpose to meet the objectives. Henceforth, the six sites were taken as six communities meeting the criteria of different scenarios of water and sanitation as planned from four districts. The process of finalizing the six communities was based on the data available from the District Water Supply and Sanitation Department under Department of Water Supply and Sewerage. Households were then selected using convenient sampling method till the required size was reached. The selection of households however was not confined to a single VDC in all the districts and nearby VDCs were considered meeting the criteria of water and sanitation situation. The sampling technique being a non purposive and community wise data being not available for the water and sanitation scenario the size of the community selected for each scenario was not calculated.

3.6 Sample Size

The sample size for each scenario was determined to be 60 considering this as the pilot study. Sixty households were selected from each of the six scenarios and hence the total sample size was 360.

3.7 Data Collection Tools/Technique

Structured Questionnaire was used to collect the data from the household level using one to one interview method.

Data on access to safe drinking water and adequate sanitation was available from the following sources:

- National or sub-national census reports
- National or sub-national household surveys
- Project reports of local NGOs

3.8 Tools Development and Pretesting

The study used structured interviews for the data collection from the households. The research instruments were developed by considering the contents of various research tools that were developed previously by different researchers. But the contents was contextualized and refined as needed. The final draft of the instruments was translated into Nepali and re-translated into English so that the notion of the study remains unchanged. Before administering them in the field, the instruments were pre-tested among the members of a community in Chitwan which was not taken for the study.

3.9 Data processing and analysis

To make the data entry easier, coding was done during the data collection. The questionnaire collected each day was verified for the completeness and consistency and editing was done. The data was entered using Microsoft Excel Program. The entered data was further cleaned and edited manually as necessary. The data was then transferred to SPSS. The analysis of the data was done by using SPSS 16.0.

3.10 Descriptive analysis

Firstly, the socio-demographic composition of the samples included in the study was described according to the categories. While describing these variables the participants from the entire scenario were taken together and analysis for different variables was done in a combined way. Furthermore, the WASH related variables of the population were analyzed in a segregated way as per the scenario taken for the study.

3.11 Bi-variate analysis

Secondly, the difference between the diarrheal disease occurrences between the groups was done using contingency tables. The purpose of this method was to identify the association between the presence or absence of toilet in different scenarios with the occurrence of diarrheal disease. The association was measured in three different groups namely household with tap water, with tube well water and spring water. And among these the cross tabulation was done by taking individual group as having toilet or not and then on the other side as diarrheal disease occurred or not in the

previous year. The association between nominal variables was assessed using Chi-square test. Association was considered statistically significant if the corresponding p-value was less than 0.05 and confidence interval at 95 percent was used to determine its magnitude.

3.12 Relative Risk Analysis:

Relative risk was calculated as mentioned above with the help of 2*2 contingency table as given below.

Situation	Disease +	Disease -	Total
No toilet	A	B	a+b
Toilet	C	D	c+d
Total	a+c	b+d	a+b+c+d

The calculation of relative risk was based purely on the findings and analysis process of this study itself.

3.13 DALY Calculation

The Disability adjusted life years (DALY) was calculated by using the formula as mentioned below.

Disability- adjusted life year (DALY): = YLL + YLD

YLLs = Premature Mortality (YLLs)

YLDs= Years lived with disability (YLDs)

The YLD is the disability component of the DALY based on non-fatal health outcomes. Disability has many dimensions including pain, discomfort, physical dysfunction, emotional distress, inability to carry out usual activities and loss of dignity, among others. In this study disability was take as the inability to carry out routine activities as a result of diarrheal disease. The YLD takes the severity and duration of the disability into account using the basic formula (Mathers, et al., 2001):

YLD = I x DW x Le

I is the number of incident cases for the reference period

DW is the disability weight in the range 0 – 1

Le is the average duration of disability (measured in years)

3.14 Reliability and Validity

To ensure the validity of participants' responses, the interviewers were trained on data collection technique, probing technique, skipping pattern and ethical consideration. Expert meetings were held during the process of tools development as well before the team moved to the field for the data collection. During field period, the interviewers were supervised and completed questionnaires were collected at the end of each day. The collected questionnaire was reviewed for missing information to ensure completeness and the problem identified on that day was discussed.

To maximize the reliability of the quantitative data, standard tool was used for individual interview. Similarly, the tools were first developed in English and later translated into Nepali to make sure that the respondents understood the questions and consistency maintained during interviewing.

3.15 Limitations of the Study

This study is carried out only in four districts so the result may not be generalized to all over the nation. The study is based on the toilet availability and water source and has not considered other factors which could have some direct or indirect role in the occurrence of diarrheal disease. This study may not explain the situation of the complete scenario including other scenarios even within district in some cases. There may be design effect on relative risk procedure and may not be appropriate in all cases. This research work may only guide similar type of research work which is on a representative sample size and representative situation in terms of practical use and predicting the study feasibility. The study has not analyzed secondary information from health facility as it is not feasible to isolate diarrheal cases based on scenario we have used. The study has not measured the physical and biological parameter of water. And diseases specific incidence is completely based on community. The combined impact on the level of disability is likely to be different from the impact of a single disease if diseases occur together. The study also has not clearly measured the severity of diarrheal illness during field study period. The selection of household was done following a non probability convenient sampling and the size of the households of the community selected for each scenario was not possible to calculate.

3.16 Ethical Consideration

Ethical approval was taken from the ERB of Nepal Health Research Council for conducting the study. While conducting the research, due respect and consideration was given to norms, dignity and protocols of the study community. First, the participants were briefed on the objectives, procedure and importance of the research before asking their verbal consent. Participants were informed that their participation in the study is voluntary, they can decide whether to participate or not or may choose not to answer any question in between if they feel that they cannot do so. Furthermore, they were informed that they can withdraw from the study at any point of time without being penalized or suffered by any problem. All information gathered from the participants are kept strictly confidential in an anonymous was and only the core research team members can have access to that. The research project is in accordance with the norms prescribed by the ethical guidelines prepared by NHRC (2011).

CHAPTER IV FINDINGS

The findings of the study are explained as a whole as well as on the basis of different scenario. Chitwan, Nawalparasi, Dhading and Dolakha districts were selected for the study purpose. There were six different scenario selected from which the primary data were collected. Burden of Diarrheal disease was calculated from the study using only the disability and calculating the burden of disability as there was no mortality recorded in the last one year prior to study.

4.1 Descriptive Findings

General findings of the study are presented combined for entire scenario together considering individual respondent from every household and the specific disease morbidity findings as well as findings related to WASH are separated for each scenario.

4.1.1 Socio-demographic Findings

4.1.1.1 Characteristics of the Participants by Age, Sex, Religion and Family Type

The age of the respondents of every households were grouped in the interval of 10 years, the sex, religion and the family type of the respondents are presented as they were recorded.

Table 1: Characteristics of the Participants by Age, Sex, Religion and Family Type

Age of Participants (Yrs.)	Frequency (N=360)	Percent
0-9	2	0.6
10-20	59	16.4
21-30	90	25.0
31-40	92	25.6
41-50	48	13.3
51-60	40	11.1
61-70	16	4.4
71 & above	13	3.6
Total	**360**	**100.0**

Sex of the Participants		
Female	193	53.61
Male	167	46.39
Total	**360**	**100**
Family Type		
Single	229	64
Joint	126	35.0
Extended	5	1
Total	**360**	**100**
Religion		
Hindu	273	75.83
Buddhist	78	21.67
Islam	3	0.83
Christian	5	1.39
Others	1	0.28
Total	**360**	**100**

Among the respondents most of them (25.6 %) are among the age group 31-40 while 0.6 per cent are only between the age group of 0-9 years. Participants in the age group 21 – 30 also had similar composition (25%) to that of 31 – 40 years. The male female composition of the participants shows that there are more female (53.61%) than male having compared to with 46.39 per cent among males.

Similarly, 64 percent of the participants are from the single family type followed by 35 percent from the joint family type and negligible from the extended family type (less than 1%). The distribution of the participants among different religion shows that just above 3/4th of the participants (75.83%) belonged to Hindu religion followed by nearly 22 percent to Buddhists and few from others namely Islam and Christian.

4.1.1.2 Characteristics of the Participants by Occupation, Education and Economic Status

The occupation of the participants in terms of their major source of income is presented in four categories namely service, business, agriculture and others. The group of participants having fallen in to the others group mainly was involved in occupation such as labors and students. Similarly, the education of the participants is presented as illiterate, primary education, secondary education, higher secondary education and university level education. Furthermore, the economic status was recorded according to the family sustainability from the total family income and presented accordingly. This was grouped as low, middle and high which represented family sustainability for less than six months, six months to one year and more than one year respectively.

Table 2 Characteristics of the Participants by Occupation, Education and Economic Status

Variables	Frequency (n=360)	Percent
Occupation in terms of major source of income		
Service	28	8
Business	88	24
Agriculture	204	57
Others	40	11
Total	**360**	**100**
Educational Status		
Illiterate	152	42.2
Primary	42	11.7
Secondary	89	24.7
Higher Secondary	53	14.7
University	24	6.7
Total	**360**	**100.0**
Economic status in terms of family sustainability		
Low (less than six month)	79	21.94
Medium (six month to one year)	194	53.89
High (more than one year)	87	24.17
Total	**360**	**100**

Majority of the study participants are found to be involved in agriculture as their major source of income (57%) followed by business 24 percent and only of 8 percent of them are found to be relying on service as their major source of income. Remaining 11 percent were found to be dependent on other source of income such as labor work. The educational status shows that more than 40 percent of the respondents are illiterate followed by 24.7 percent and 14.7 percent of them are having secondary and higher secondary education respectively. Remaining 11.7 percent have been found to have primary education, and only 6.7 % the university degree. On the basis

of the major source of income, family sustainabilty status shows that 53. 89 percent of the participants are from the medium group that is the income can sustain their family for upto one year. There are nearly 25 percent of them in the high category that is their annual family income can sustain them for more than one year followed by around 22 percent of the participants in the low ecnominc status group that means theie annual family income is just enough to suatain them for less than six months.

4.1.2 Findings of diarrheal disease and related conditions in different scenario

Diarrheal diseases as found among the participants in the last one year prior to survey has been presented in total as well as in different scenario. Similarly, the findings of the participants who suffered from diarrhea are presented as mean number of days suffered from diarrhea, number of episodes of diarrhea as well as mean duration of illness that is duration of diarrhea in the past one year.

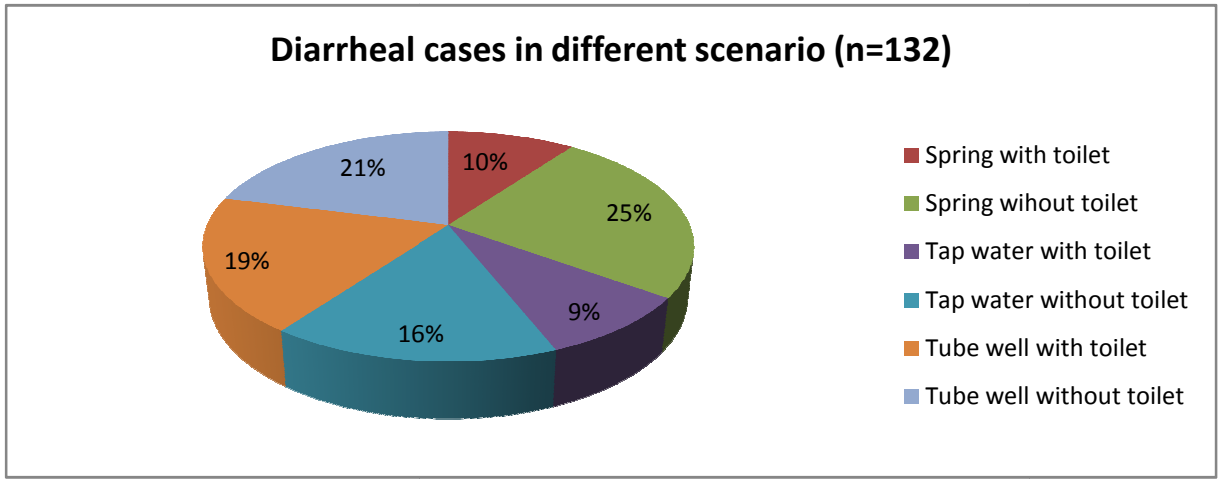

Figure 1: Diarrheal Cases among all the Participants

The above figure shows the occurrence of diarrheal disease in different scenario among total of 132 cases. Highest percentage of diarrhea case 25% is seen in scenario spring without toilet followed by 21 percent in scenario of tube well without toilet and then 19 percent in scenario of tubewell with toilet. A similar percentage 16% is found in scenario of tap water without toilet and the lowest 9% in the scenario tap water with toilet.

Occurrence of diarrheal disease within different scenario

The occurrence of diarrhea as found in different scenario is presented as below with distribution within the group.

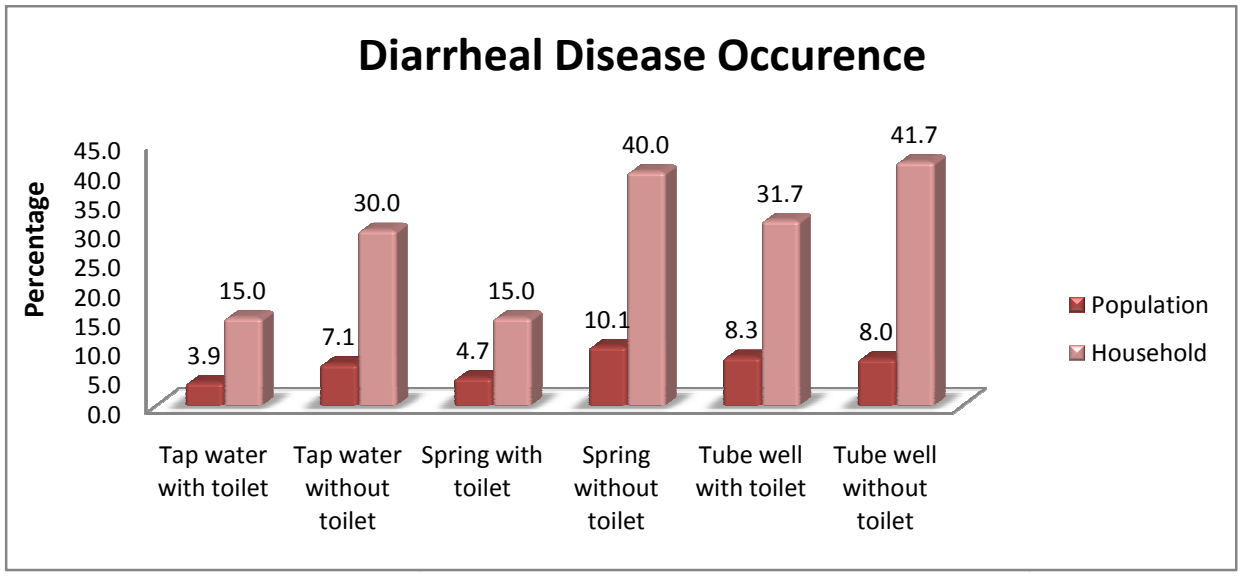

Figure 2: Occurrence of diarrheal disease within different scenario

The above figure shows the distribution of the diarrheal cases on different scenario in the past one year in terms of household and population affected. In the scenario tap water with toilet, 3.9 % (n=304) of population and 15 % (n=60) of household respectively suffered from diarrhea and in the scenario tap water without toilet, 7.1 % (n=296) of the population and 30 % (n=60) of household respectively suffered from diarrhea.

Similarly, in scenario spring with toilet 4.7 % (n=274) of population and 15 % (n=60) of household respectively suffered from diarrhea and in scenario spring water having no toilet the proportion of population and household suffering from diarrhea was 10.1% (n=327) and 40% (n=60) respectively. Finally in scenario tube well with toilet 8.3% (n=302) of population and 31.7% of household (n=60) suffered from diarrhea and in scenario tube well without toilet 8% (n=351) of the population and 41.7 % (n=60) of the household suffered from diarrhea.

Different features of illness (diarrhea) in different scenario

Various features of illness (diarrhea) among those who suffered from diarrhea in the past one year have been presented as per the different scenario. The number of days suffered from diarrhea, the number of episodes of diarrhea and the duration of diarrhea in the past one year all are expressed in terms of mean value. The duration here implies the number of days every individual is disabled due to diarrhea that is not able to continue his/her routine work.

Table 3 Distribution of Mean number of days suffered and mean number of episodes in different scenario

Scenario / **Illness Features**	Tap water with toilet	Tap water without toilet	Spring with toilet	Spring without toilet	Tube well with toilet	Tube well without toilet
Average Number of days suffered	2.58	4.52	2.31	7.61	4.16	4.86
Average Number of episodes	1.17	1.62	1.23	2.03	1.40	1.82

The above table shows the mean distribution of diarrheal disease according to the number of days suffered and episodes of disease. Mean number of days suffered from diarrhea disease and no of episodes is high with scenario having spring water without toilet viz. 7.61 days and 2.03 respectively. The lowest average of diarrheal episodes is found in scenario having tap water with toilet (1.17).

4.1.3 Findings related to Water and Sanitation

Water treatment behavior of Participants

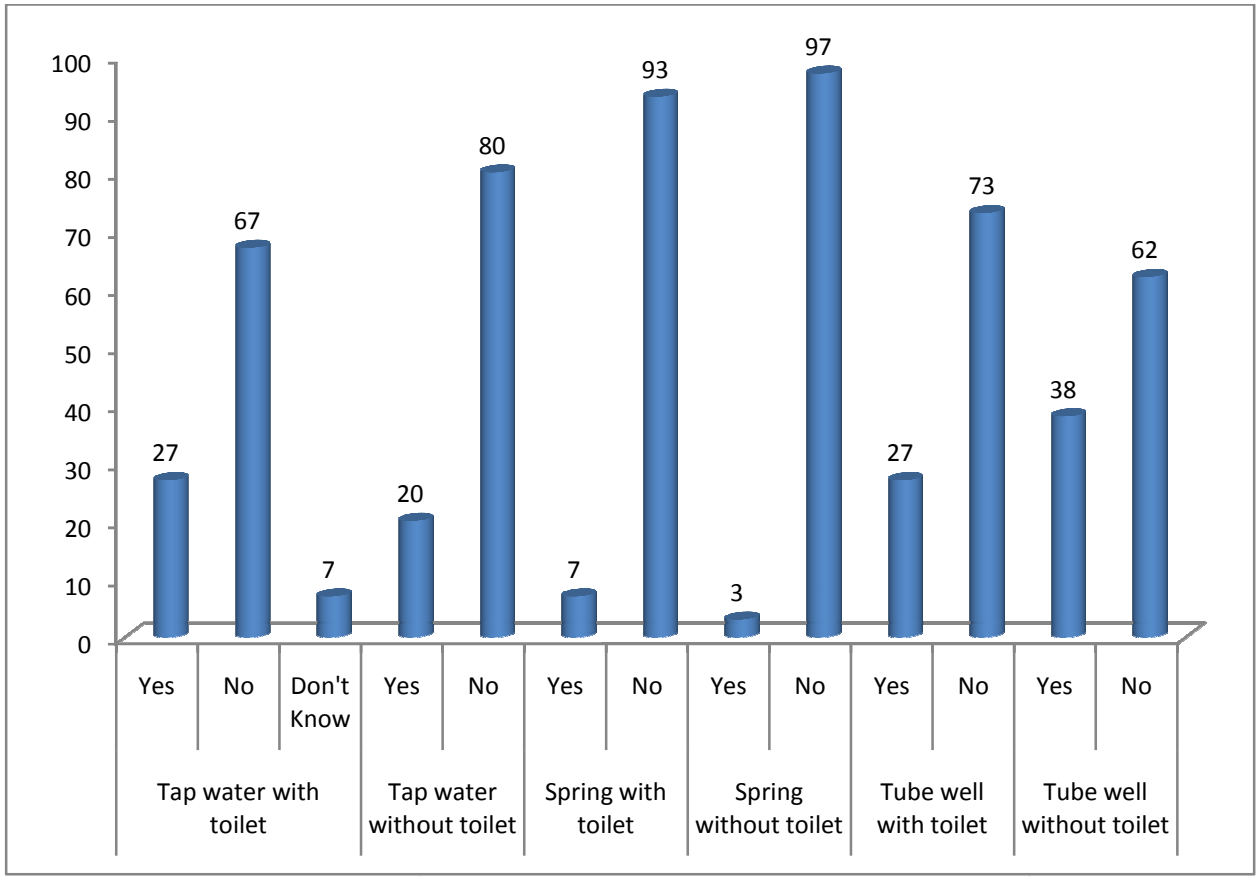

Figure 3: Water treatment behavior of Participants

The figure shows the percentage of household doing the treatment of drinking water at household level. Most of the respondents said that they do not treat water and consume directly from source in almost all scenarios, only 7 percent in scenario with spring having toilet and 3 percent in scenario with spring not having toilet have been found to be treating water for consumption. In contrary 20 percent in scenario having tap water without toilet, 27 percent each in scenario having tap water with toilet & tube water with toilet and 38 percent in scenario having tube well with no toilet mentioned that they treat drinking water before consumption.

Treatment methods adopted for drinking water in different scenario

Among the people who treat water before consuming, they were found to be using different treatment methods for water which has been presented in the following table.

Table 4 Treatment methods adopted for drinking water

Scenario / **Treatment Method**	Tap water with toilet (n=21)		Tap water without toilet (n=15)		Spring with toilet (n=4)		Spring without toilet (n=1)		Tube well with toilet (n=16)		Tube well without toilet (n=30)	
	N	%	N	%	N	%	N	%	N	%	N	%
Boiling	8	38.1	7	46.7	3	75	1	100	8	50	6	20
Water Filter	5	23.8	6	40	1	25	-	-	7	43.8	22	73.30
SODIS	2	9.50	2	13.3	-	-	-	-	1	6.20	1	3.30
Add Bleach	5	23.8	-	-	-	-	-	-	-	-	-	-
Let it Stand & Settle	1	4.80	-	-	-	-	-	-	-	-	1	3.30
Total	**21**	**100**	**15**	**100**	**4**	**100**	**1**	**100**	**16**	**100**	**30**	**100**

The above table shows the different methods of water treatment followed by the people who were found to be treating the water before consumption. Most of the households use filtration and boiling method while only few of them use SODIS, Chlorination and other method. The situation is similar in almost all the scenario.

Types of toilet used

Out of the six scenario the types of toilet used by the three scenario has been dicsussed as below.

Table 5 Type of toilet used by the people

Types of Toilet	Flush/Pour flush toilet		Pit Latrine		Pit latrine without slab		No facility		Ventilated improved latrine	
Scenario	N	%	N	%	N	%	N	%	N	%
Spring with toilet	18	30	28	47	14	23				
Tap water with toilet	47	78	3	5			10	17		
Tube water with toilet	16	27	19	32	1	2			24	40

The table shows use of different types of toilet used in three scenarios of 180 household having toilet (60 households in each). In scenario spring with toilet 30 percent use Flush/Pour flush toilet, 47 percent use Pit toilet and 23 percent use pit latrine without slab. Similarly, in scenario tap water with toilet 78 percent use Flush/Pour flush toilet, 5 percent Pit latrine while 17 percent use toilet having no facility. In scenario tube water with toilet 27 percent use Flush/Pour Flush toilet, 32 percent Pit latrine, 2 percent pit latrine without slab while 40 percent use ventilated improved latrine.

Hand washing practice

Hand washing practice of participants in different scenario has been presented as whether they wash their hands or not after defecation as well as before eating food. Similarly, different materials used by the participants also have been presented for different scenario.

Table 6 Hand washing practice among the participants

Hand Washing Practice	Wash hand after defecation		Washing hand before eating food	
Scenario	Yes	No	Yes	No
Tap water with Toilet	100.0	0.0	100.0	
Tap water without toilet	65.0	35.0	100.0	
Spring with toilet	98.3	1.7	100.0	
Spring without toilet	95.0	5.0	96.7	3.3
Tube well with toilet	96.7	3.3	96.7	3.3
Tube well without toilet	91.8	8.2	93.4	6.6

The above table shows the hand washing practice and behavior of the household of different scenario. The response of hand washing after defecation and before eating food is more than 90 per cent in almost all of the scenario. In some cases the practice is seen upto 100 percent. However, it is seen that an unexpectedly high (35%) proportion of the participants from scenario tap water without toilet do not wash hands after defecation.

4.2 Relative Risk Analysis

Risk Calculation for different scenario with or without toilet

Among the different scenario of water and sanitation, the scenario were grouped into three as per the water source for calculation of risk. Hence, the risk of having diarrheal disease was calculated for water sources having toilet or not. This calculation was done using the data generated purely from the study and the method as well was not based on any other's calculation method. The total diarrheal cases as seen before was not taken for the risk calculation as the total figure includes one or more diarrhea patients within single household. Hence, the presence of diarrheal disease in every household was taken as anyone suffered from diarrhea in the past one year. Even if there were one or more diarrhea cases in the household that was considered as just the presence of diarrhea.

Table 7 Risk of diarrheal disease between scenarios

Cross Tabulation for Scenario with or without toilet with diarrheal disease				
	Diarrheal Disease		Total	OR (95% CI)
Scenario	Yes	No		
Tap water without toilet	18	42	60	2.428 (0.989-5.963)
Tap water with toilet	9	51	60	
Total	33	87	120	
Spring without toilet	24	36	60	3.778 (1.572- 9.079)
Spring with toilet	9	51	60	
Total	27	93	120	
Tube well without toilet	25	35	60	1.541 (0.730-3.256)
Tube well with toilet	19	41	60	
Total	44	76	120	

The above table shows that in the first group that is the group with water source as tap water, it has been found that the risk of having diarrheal disease is almost two and half times {OR 2.428 (95% CI 0.989-5.963)} higher among the group without toilet then among the group with toilet. However, the relation here is not statistically significant as shown by the value of 95 %CI.

Similarly, in the second group that is the scenario with water source as spring, the risk of having diarrheal disease is nearly 4 times {OR 3.778 (95% CI 1.572-9.079)} higher among the group of

participants without toilet then among the participants with toilet. And the relation is statistically significant as shown by the value of OR with 95% CI.

In the third situation of water source as Tubewell, the risk of having diarrheal disease is one and half times {OR 1.541 (95% CI 0.730-3.256)} higher among the group without toilet then among the group with toilet. However, the relation here is not statistically significant as shown by the value of 95 % CI.

Risk calculation for entire scenario with one control (Reference)

Table 8 Risk of diarrheal disease for all scenarios with one reference

Risk Estimation for Entire Scenario					
	Diarrheal Disease		Total	P Value	OR (95% CI)
Scenario	Yes	No			
Tubewell without toilet	25	35	60	0.002	4.05 (1.69-9.71)
Tubewell with toilet	19	41	60	0.034	2.63 (1.07-6.42)
Spring without toilet	24	36	60	0.003	3.78 (1.57-9.08)
Spring with toilet	9	51	60	1.000	1.00 (0.37-2.72)
Tap water without toilet	18	42	60	0.053	2.43 (0.99-5.96)
Tap water with toilet*	9	51	60	*	

For estimation of the risk of diarrheal disease for different scenario, one scenario tap water with toilet was taken as the reference (control) scenario. Based on this risk estimation was done using binary logistic regression.

The results showed that people in the scenario tap water without toilet are almost two and half times {OR 2.43 95% CI (0.99-5.96)} at risk of acquiring diarrheal disease then the people in the reference scenario. This risk is however statistically not significant as the value of CI indicates even though the p value is less than 0.05.

Similarly, the risk of diarrheal disease for the scenario spring with toilet is not different than the scenario as shown by the statistics. The risk of diarrheal disease for the scenario spring without toilet is nearly four times higher than the reference scenario. The relation is statistically significant with odds ratio of 3.78 {95% CI (1.57-9.08)} and p value 0.003.

The risk of diarrheal disease for the scenario tube well with toilet is more than two and half times higher than the reference scenario. This is statistically significant with odds ratio of 2.63 {95% CI (1.07-6.42)} and p value of 0.034.

Finally the risk of diarrheal disease for the scenario tube well without toilet is more than four times higher than the reference scenario. The relation is statistically significant with odds ratio of 4.05 {95% CI (1.69-9.71)} and p value of 0.002.

4.3 YLD for different scenario

Table 9 YLD for different scenario

Scenario	Incidence of Diarrheal Disease/1000 Population	Average number of days suffered/episode (Duration of diarrheal Disease)		Years Lived with Disability (YLD) per 100,000 Population
		Days	Years	
Tap water with toilet	46.05	2.21	0.006055	2.3977
Tap water without toilet	114.86	2.79	0.007644	7.5497
Spring with toilet	58.39	1.88	0.005151	2.5862
Spring without toilet	204.89	3.75	0.010274	18.1005
Tube well with toilet	115.89	2.97	0.008137	8.1088
Tube well without toilet	145.30	2.67	0.007315	9.1398

The YLD was calculated for each scenario by using the disability weightage of 0.086 and duration of illness as average number of days suffered from diarrhea within each scenario converted into years. The duration of illness here is the average number of days people suffered from diarrhea per episode within each scenario. This was calculated using the findings from each scenario.

The incidence of diarrheal disease was used as mentioned above for each scenario using the data collected. While calculating the incidence the number of episodes of diarrhea and number of people who suffered from diarrhea was considered. The average number of diarrheal episodes was calculated from the number of episodes of diarrhea within the scenario among the people who reported to have suffered from diarrhea within the past year. The product of this average number of episodes and number of people as mentioned above within the scenario was considered to calculate the numerator for incidence calculation. The denominator for the calculation was the population size within each scenario of the households taken. Using this numerator and denominator the incidence of diarrheal disease was calculated by using the formulae as shown in the annex.

With this the YLD was calculated with 3% discounting and uniform age weights. The YLD was initially calculated for per thousand population and later converted to per hundred thousand population.

It shows that the YLD is highest for the scenario Spring without toilet that is 18.10 years lived with disability per hundred thousand population, followed by 9.14 years for scenario tube well without toilet. It is quite similar for scenario tap water without toilet and tube well with toilet, 7.55 and 8.11 years respectively. The scenario tap water with toilet has the least years of disability lived that is 2.39.

This finding is in somewhat in contrary to the risk of diarrheal disease. This difference could be due to the input data used for the calculation. For the risk estimate the occurrence of diarrheal disease is used whereas for the calculation of YLD the average number of episodes of diarrhea and average duration of diarrheal disease in the past year was used.

CHAPTER V DISCUSSION

Diarrhea illness is a leading cause of mortality and morbidity in developing country. Previously few studies have attempted to identify the factor that contributes on diarrheal illness but only few studies have been conducted in community-scenario based diarrheal diseases burden. Diarrheal diseases are emerging due to poor water sanitation and hygiene practice, which contributes the loads of microbial contamination in drinking water. In case of Nepal, the water supply and distribution mechanism in most of the districts are not fully regulated and managed. National standard guidelines should promote the distribution and consumption of safe and clean water based on different parameters, though this are not analyzed and studied in this study. (Khanal et al., 2006)

The main purpose of this study is to take the scenario based approach to assess morbidity and mortality on diarrheal diseases burden due to unsafe drinking water, poor sanitation and personal hygiene. Regarding the findings from previous related studies we could not access exactly similar type of published research work. However, discussion has been done with somewhat similar type of studies done previously. The average estimated incidences of diarrhea in different populations and the average duration of each episode have been obtained by review of incidence data from published and unpublished literatures. A study has revealed more than 1.71 and 0.63 episodes/person/year in rural and 1.09 and 0.33 episodes/person/year in urban among below 6 years and above respectively, and average duration of disability has manipulate 0.01096 years, which may be national duration of disability due to diarrhea (WHO, 2008 & RGI, 1996). But in current study, average estimated incidence based on episodes of diarrhea and YLD differ from scenario to scenario and the lowest incidence value has been found to be 49.86 episodes /person/year and, YLD is 3.9937 per hundred thousand populations which was calculated using the duration of diarrheal disease from the national average duration of diarrheal disease. In current study the estimated value has been found to be increasing with the increase of additional unimproved environmental load. The small value of incidence of diarrheal episode and YLD in current study may be because of scenario based small scale study. World Health Organization has estimated the relative risk of diarrheal disease from global communities, based on the pathogen load on drinking water and sanitation coverage. The relative risk has been assumed to be 1 in ideal situation, corresponding to the absence of transmission of diarrhea and 6.1 (at

minimal) where no improved water supply and no basic sanitation in a country that is not very high extensively covered by those services, and where water supply is not routinely controlled (Prüss A. et al., 2002). It has reflected the relative risk reduction due to various level interventions from various published and unpublished document from developed and developing countries. Relative risk has been computed from various scenario of Kathmandu valley- central region of Nepal which has RR ranging from 1 to 15.53, where relative risk 1 refers to tube well having toilet facility available and 15.53 refers to spring water without toilet(Khanal et al., 2006). This research work is based on primary and secondary source which is somewhat similar to current study. In the current study for estimation of the risk of diarrheal disease for different scenario, one scenario Tap Water with Toilet was taken as the reference (control) scenario, which is considered as, the least contaminated scenario because all household has found better practice of water sanitation and hygiene practice. The drinkable water has already been chlorinated and more than ninety percent people have been aware about the factors causing diarrheal diseases. And the people in the scenario tap water without toilet are almost two and half times at risk of acquiring diarrheal disease then the people in the reference scenario. The risk of diarrheal disease for the scenario (tube well with toilet) is more than two and half times higher than the reference scenario. Similarly, the risk of diarrheal disease for the scenario (spring without toilet) is nearly four times higher than the reference scenario.

Relative risk of diarrheal disease is found to be higher in those scenarios that don't have toilet with respect to the scenario having toilet which shows that there may be greater transmission of disease and high disease load in scenario not having toilet. Greater odds of disease transmission are found to be high in spring water in comparison to tube and tap water. Sanitation and hygiene are the prime components to promote healthy living and is the best prevention practice to halt the disease transmission. Lack of full sanitation and relatively poor hygiene may be reason for the occurrence of high disease burden in spring water consuming community who don't have toilet. In addition to that, poor economy and behavioral factors induced by low education may be considered for the diarrheal disease burden (Khanal et al., 2004).

CHAPTER VI CONCLUSION

6.1 Conclusion

There is complex link between environmental situation and their health outcome. Health outcome is always influenced by the magnitude and intensity of environmental risk factor in which population are exposed. Water, sanitation and hygiene related factor can be considered as a determining component for causal burden of diarrheal diseases.

In current study diarrheal diseases episode and disability is found higher in spring water having no toilet facility in comparison to other situation. Mean number of days suffered from diarrheal disease and no of episodes is high with scenario having spring water without toilet viz. 7.61 days and 2.03 respectively. The lowest number of diarrheal episodes is found in scenario having tap water with toilet (1.17).

Out of the total diarrheal cases of 132 in all the six scenarios the proportion was highest (25%) in scenario spring without toilet and the lowest (9%) in the scenario tap water with toilet. However, the percentage of people suffering from diarrhea within the scenario was highest (10.1 %) in the scenario spring without toilet and lowest (3.9 %) in scenario tap water with toilet. As per this among the entire scenario, people consuming spring water having no toilet were found to be suffered more from diarrhea.

The risk of having diarrheal disease is nearly 4 times higher among the people from scenario spring without toilet then among the participants with toilet with statistical significance. In the group with water source as tap water, it has been found that the risk of having diarrheal disease is almost two and half times higher among the group without toilet then among the group with toilet. In the group with water source as Tubewell, the risk of having diarrheal disease is one and half times higher among the group without toilet then among the group with toilet. These two relations are however without any statistical significance.

The risk of acquiring diarrheal disease is found to be 2.43 times higher in scenario tap water without toilet than scenario tap water with toilet (reference) without any statistical significance. The risk in other scenarios namely scenario spring without toilet, tube well with toilet and tube well without toilet is 3.78, 2.63, 4.05 times higher respectively than the reference scenario with

statistical significance. However the risk with spring with toilet is not different than the reference scenario as shown by the statistics.

YLD is highest and lowest respectively for the scenario spring without toilet and tap water with toilet that is 18.10 and 2.39 years lived with disability per hundred thousand population. This finding is in somewhat in contrary to the risk of diarrheal disease. This difference could be due to the input data used for the calculation. For the risk estimate the occurrence of diarrheal disease is used whereas for the calculation of YLD the average number of episodes of diarrhea in the past year was used. However, premature mortality has not been reported.

Diarrhea is a preventable disease through effective intervention strategy with addressing the wide range of issues on education, economic development and proper awareness.

6.2 Recommendations

- Methods and result of this study can be used for the district wise calculation of burden of diarrheal disease based on water supply and sanitation practice.
- This research study can be taken as a pilot study for further study.
- The government should focus on improving the sanitation status of the people mainly toilet facility.
- Further studies should try to tally the mortality and morbidity data with that of health facility where feasible.
- There should be awareness programs focusing on good sanitation and hygiene practices.

Some recommended steps for district wise calculation of burden of diarrheal disease

Area identification is initial step for conducting this study; it can be done based on distribution of exposed population on various risk levels of water supply system and sanitation coverage area. The study area can be identified and categorized according to following situation.

1. The study area within the district without improved water supply and without basic sanitation that is, not extensively covered by those services, and where water supply is not routinely controlled. Unimproved water supply here implies to the source of drinking

water such as river or canal, unprotected stone spout, pond or spring etc and absence of basic sanitation implies to the absence of toilet facility lacking good hygiene and sanitation practice.

2. The study area within the district with improved water supply but without basic sanitation that is, not extensively covered by basic sanitation but has improved water supply however the water supply is not routinely controlled. This kind of water supply here implies to the source of drinking water such as protected water source like public tap water, sand pipe, tube well, bore hole, protected dug well, protected spring and protected rain water collection or reservoir and which lacks the routine disinfection practice and without basic sanitation implies to the unimproved sanitation facility which may include open latrine, toilet with excreta flushed to the street, yard or plot, no toilet facilities or bush of field.
3. The study area within the district with basic sanitation but without improved water supply that is not extensively covered by those services, and where water supply is not routinely controlled. This kind of water supply here implies to the unprotected source of drinking water such as unprotected sand pipe, tube well, bore hole, unprotected dug well, unprotected spring and unprotected rain water collection or reservoir and which lacks the routine disinfection practice and the basic sanitation implies to the presence of modern toilet facility.
4. The study area within the district with improved water supply and with improved basic sanitation, where there is improved access to drinking water (generally piped to household) and basic sanitation as well as improved personal hygiene and drinking water disinfected at point of use. However, water supply is not routinely controlled. The improved water supply here implies to piped public tap water, tubewell, borehole, protected dug well, protected spring or protected rain water collection. The improved basic sanitation implies to the availability of modern toilet.
5. The study area within the district that meets the criteria above in number 4 but the water supply is routinely controlled. However, this ideal situation may not be practically available.

After identifying the area (scenario) of exposed population and risk factors, we can follow this report for collecting information (annex- Data collection tool). However, for the selection of the

households it is recommended that a probability sampling technique is followed rather than a non probability convenient sampling. For this it is further recommended that the size of the community selected that meet the criteria should also be tried to be estimated beforehand. Even before reaching to the households if there are too many similar or same scenarios found available within the district meeting the criteria we may follow the probability sampling technique to select the required scenarios. Finally calculating the district wise burden of diarrheal diseases in terms of Disability- adjusted life year (YLL + YLD), can be done using the method as given above. However, for the calculation of YLL which was actually not performed in this study could be done as follows. YLL= NxL where N is the number of deaths and L is the standard life expectancy at age of death (in years).

Annexes

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2. Formulae used for different calculation

a) YLD Calculation

YLD = I x DW x Le

I is the number of incident cases for the reference period. Here the incidence referred to the number of diarrheal cases within each scenario for the reference period.

DW is the disability weight in the range 0 – 1. The DW here is used as 0.086.

Le is the average duration of disability (measured in years). The average duration of illness here referred to the average number of days suffered from diarrhea per episode within each scenario.

b) Incidence Calculation

Incidence

$$I = \frac{\text{Average number of episodes} * \text{Number of people suffered with diarrhea}}{\text{Total Population}} * 1000$$

Average number of episodes was the mean of the episodes of diarrheal disease within each scenario.

Number of people suffered with diarrhea is the total number of people suffered from diarrhea within each scenario.

Total population is the total number of people within the 60 households of every scenario.

3. List of Facilitators

Focal person of district water supply and sanitation department of all the four districts were contacted for the field study. Engineers and chief of all departments of respective districts helped to identify the study area and facilitated the study. Following person were mobilized as local facilitators in the respective districts as mentioned below:

S.N	Name	District	Address
1	Asish Sapkota	Chitwan	Fulbari VDC, Working in local club
2	Shree Krishna Shrestha	Dhading	A local of Dhading besi
3	Jayan Harijan	Nawalparasi	A local of Unwach VDC
4	Suman Shrestha	Dolakha	A local student of Orang -6

4. Data Collection Tools

Estimating the Burden of Diarrheal Disease caused by Water and Sanitation

Nepal Health Research Council

Nepal Government, Ministry of Health and Population

Questionnaire Survey

Interviewer's Profile

Name: …… Signature: …….

1. Name of Household's Head: ……
2. District: ……...
3. V.D.C/Municipality: ……..
4. Ward No.: ……...
5. Village Name: …….
6. Date: ……

Demographic Information (Respondents)

Name:

Age:

Sex:

No. of family members: ……

Family Type: Single ☐ Joint ☐ Extended ☐

Religion: Hindu ☐ Buddhist ☐ Islam ☐
Christianity ☐ Others (Specify)……

Educational Status: Illiterate……...1

No of Schooling (time period)……..

Major source of income:

Service……1 Business……..2

Agriculture…….3 Others (specify)…….

Family sustainability (based on major source of income): Less than six month: ☐

Six month to one year: ☐

More than one year: ☐

Diarrheal illness (Within past one year of history):

Morbidity related questionnaire

1. **Was anyone from your family suffered from diarrhea?**
   Yes……..1 No…… 2 don't know……3
2. **If yes, provide the information.**

Name	Sex	Age	No of days suffered	No. of Episodes

3. **Were the following sign and symptoms seen in the person?**
   White watery stool Yes …….1 No…….2
   Fever Yes …….1 No ……2
   Blood in stool Yes……..1 No…….2
   Vomit Yes……..1 No…….2
4. **What was the treatment measure applied for the diarrhea?**
   ORS (Number of packets) ……Yes ……1 No ……2
   IV fluid (Number of bottles)……...Yes…….1 No ……2
   Antibiotic…….. Yes…....1 No…….2
   Others……..

5. **Were any members from your family unable to work due to diarrhea?**
   Yes…….1 No…….2
   If yes provide information:

Name	Sex	Age	Duration of illness(Days, months)

Mortality related questionnaire:

6. **Do any member of your family lost life due to diarrhea?**
   Yes …….1 No……2

If yes, provide information:

Name	Sex	Age at death (years)	Cause of death

***Water related questionnaire*:**

7. **What is the source of your drinking water?**
   River……..1 Pond……....2
   Well……...3 Public Tap…4
   Tap (At home)……5 others (specify) ……..6
8. **How much time does it take to bring water?**
   Less than 15 mins……..1 15 to 30 mins…….2
   30 mins to 1 hr……3 More than 1 hr…..4
9. **Is the source of water protected?**
   Yes……1 No……..2

10. **Do you treat your drinking water before consumption to make it safer?**

    Yes…….1 No……...2
    Don't Know……3

11. **If yes, what method do you apply to make water safer for drinking?**
    a. Boil yes….1 no……2
    b. Add bleach(like chlorine) piyush, Waterguard etc yes……..1 no……..2
    c. SODIS yes……1 no……..2
    d. Water filter yes…….1 no……..2
    e. Let it stand and settle yes……1 no……..2
    f. Don't know yes……1 no…….2
    g. Others (specify)……
12. **Is there any treatment and disinfection made at water source before supply to household level?**
    Yes…….1 no……2
    don't know…….3

13. **Have you been suffered from any health problem by drinking that water?**
    Yes……..1 No…….2
14. **If yes, what were the health problems that you faced?**
    Mention……

Hygiene and Sanitation related questionnaire

15. Do you wash vegetables before cooking?
Yes……..1 No……2

16. When do you consume food soon after cooked?
Immediately…….1 less than one hour…….2
1-6 hour…….3 6-12 hour…….4
More than one day…….5

17. How do you protect your food stuffs?
Mention…….

18. Do you have toilet at your home?
Yes…….1 No……2

19. What kind of toilet facility do members of your household usually use?

a. Flush or pour flush toilet
b. Pit latrine
c. Compositing toilet
d. Flush or pour-flush to elsewhere
e. Pit latrine without slab or open pit
f. No facility
g. Ventilated improved latrine
h. Others (specify)…….

20. Do you wash hand after defecation?
Yes…….1 No……..2 (if no go to Q. 22)

21. How often you wash hand after defecation?
Always……..1 Sometimes……..2
Never……..3

22. Do you wash hand before eating food?
Yes……1 No……..2

23. How often you wash hand before eating food?
Always……..1 Sometimes……..2
Never……..3

24. If so, what do you use to wash hand?
1. Soap Yes……1 No……2
2. Ash/water Yes……1 No……2
3. Only water Yes……1 No……2

25. Is your toilet shared with other households? Yes……1 No……..2