A CASE STUDY ON THE RAINWATER HARVESTING SCHEMES OF RWSSP-WN IN KYAKMI VDC, SYANGJA DISTRICT AND SWARGADWARI KHAL VDC, PYUTHAN DISTRICT IN THE CONTEXT OF CLIMATE CHANGE IMPACTS AND COMMUNITY VULNERABILITIES

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EXECUTIVE SUMMARY

Rainwater harvesting has become an important water source in many areas with significant rainfall but because of climate change, rainfall pattern is changing and affecting the water availability. People in rural communities are experiencing drying water sources, ground water depletion, irregular rains, and high intensity rainfall. These people are affected the most by the impacts of climate change. A case study on rainwater harvesting schemes (RWHS) in Purkot, Kyakmi VDC in Syangja district and Swargadwari Khal VDC in Pyuthan district was done to assess the schemes of RWSSP-WN in the context of climate change impacts and community vulnerabilities. Household questionnaire survey, focus group discussion, key informant interviews and field observations were used to collect data from the study area. For data analysis, Microsoft Excel 2007 was used. Findings were obtained by analyzing the primary and secondary data and presented in simple bar and chart graphs.

The findings showed that the households surveyed were benefitted by the installation of RWH systems which were well maintained and working well with more than 50 % of respondents fully satisfied with the systems. The major inconvenience with RWH system was the insufficient capacity of the tank; making the communities still dependent on the spring source and controlling the use of rainwater with the start of dry periods. Drought and irregular rainfall were the changes perceived by the community people in recent years that had affected the water availability in the community resulting less water available in the RWH system and drying spring sources. Few respondents were aware of the concept of climate change and its impacts. Most of the respondents expressed that RWH could be a useful method in cases of drought and drying spring sources as rainwater is stored in the tank and available for use. During focus group discussions, the identified local climate hazard in both study area was drought and especially women to be more vulnerable to its impacts. According to the community people, recharge pond construction and tree plantation programme were the strategies that could be adopted for reducing the impacts of drought in the community. Based on the findings and observation, the conclusions and recommendations were made.

ACKNOWLEDGEMENT

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LIST OF ACRONYMS

AEPC: Alternative Energy Promotion Center

BSP: Bio-gas Support Programme

CBS: Central Bureau of Statistics

DWSS: Department of Water Supply and Sewerage

DDC: District Development Committee

ENPHO: Environment and Public Health Organization

GHG: Greenhouse gas

GLOFs: Glacial Lake Outburst Floods

GWS: Gurkha Welfare Scheme

HDPE: High Density Polyethylene

IPCC: Intergovernmental Panel on Climate Change

LFP: Livelihoods and Forestry Programme

MoPE: Ministry of Population and Environment

NAPA: National Adaptation Programme of Action

NEWAH: Nepal Water for Health

NGO: Non Governmental Organization

NRCS: Nepal Red Cross Society

NWCF: Nepal Water Conservation Foundation

RWH: Rainwater Harvesting

RWHS: Rainwater Harvesting Schemes

RWSSP-WN: Rural Water Supply and Sanitation Project in Western Nepal

RAIN: Rainwater Harvesting Implementing Network

UNFCCC: United Nations Framework Convention on Climate Change

VDC: Village Development Committee

WARMP: Water Resource Management Programme

WASH: Water, Sanitation and Hygiene

WUSC: Water Users' and Sanitation Committee

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1. BACKGROUND

1.1 Climate change and its impacts on water resources

Climate change has become one of the major global issues in recent years. The United Nations Framework Convention on Climate Change (UNFCCC[1]) defines climate change as "*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*". Changes in climate can be caused by natural events and processes and by human influences. Key natural factors that can influence climate change on century time scales include changes in the intensity of sunlight reaching the earth and in the concentration of volcanic dust in the atmosphere. Whereas key human influences include changes in greenhouse gas (GHG)[2] concentrations (due to burning of fossil fuels, industrial & vehicular emissions) and alteration in land use. These influences both affect the amount of heat energy escaping to space, and the overall effect of these activities has been a warming effect known as global warming that is increase in temperature of the earth's surface due to greenhouse effect. The build-up of GHGs in the atmosphere is the primary cause for concern about climate change now and over the coming century. (www.climatechange.gc.ca)

Climate change is a very serious topic because of the fact that it poses adverse impacts in different sectors like water resources, agriculture, health, forest and biodiversity. Observational records and climate projections have revealed that water resources are highly vulnerable to climate change with wide-ranging consequences on human societies and ecosystems (IPCC[3],

[1] UNFCCC is an international treaty that sets out an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. Its ultimate objective is to stabilize atmospheric concentrations of greenhouse gases at a level that would prevent dangerous human interference with the climate system.

[2] Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbon (HFC), Perfluorocarbon (PFC) and Sulphur Hexafluoroide (SF) are the principal greenhouse gases (GHGs) responsible for global climate change. Carbon Dioxide is the major component of global climate change.

[3] Intergovernmental Panel on Climate Change (IPCC) is a scientific, interdisciplinary body established by the World Meteorological Association (WMO) and the United Nations Environment Program (UNEP). Its role is to assess the latest

2008). More than 60% of the impacts observed today because of climate change fall on the water resources. The overall impacts of climate change on water resources are "*too much water and too little water*", "*wrong type of water*" and "*wrong time of water*". As a result of climate change, the rainfall pattern is changing. So, some areas are receiving high amount of rainfall or in other words *too much water* resulting in floods and landslides whereas some areas are receiving *too little water* resulting in droughts and water scarcity. Such events make the water availability scarce or making water unsafe due to contamination. The *wrong type of water* is causing different water borne diseases, leading to loss of lives and property. Also there is the *wrong time of water* that is no rainfall when expected and rainfall when least expected. All this is because of the changing climate. (Thapa, 2010)

1.2 Climate change impacts in Nepal

Climate change vulnerability[4] analysis shows that Nepal is highly vulnerable to climate change. It indicates that more than 1.9 million people are highly climate vulnerable and 10 million are increasingly at risk, with climate change likely to increase this number significantly in the future (NAPA, 2010). Although, Nepal has a negligible share in the greenhouse gases emission globally that is only 0.025% of the total global GHGs emission, it is more vulnerable to the impacts of climate change (MoPE, 2004). Observed data indicates consistent warming and rise in the maximum temperature at an annual rate of 0.04 – 0.06 ° C (NAPA, 2010). This rapid rate of warming is resulting in the melting of glaciers and the likelihoods of Glacial Lake Outburst Floods (GLOFs) which can create massive loss of life, property and infrastructures. Analysis of observed precipitation data in Nepal has revealed changed precipitation patterns i.e. decreasing number of annual rainy days, increasing number of extreme precipitation events and increasing days with higher precipitation amount, which intensifies the likelihoods of landslides, floods and droughts (Baidhya et al., 2008). Changes in precipitation and temperature

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scientific, technical, and socio-economic literature produced worldwide relevant to understanding the risk of human-induced climate change, its observed and projected impacts, and options for adaptation and mitigation.

4 "Vulnerability is the degree to which a system (or a household or a community) is susceptible to and unable to cope with, adverse effects of climate change". (LFP, 2010)

lead to changes in runoff and water availability. Drought-affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, e.g. agriculture, water supply, energy production and health (IPCC, 2007). Practical Action (2010) reported that with climate change, the water sources in the middle hills of Nepal have been affected with reported events of drought and drying up of spring sources. Rural communities are observing changes in rainfall patterns such as monsoon tends to begin later, the rainfall is more irregular, flash floods are more frequent and winter rains are reduced. People are noticing that summers are hotter and winters generally less cold.

1.3 Climate change adaptation and mitigation measures

The impacts of climate change are inevitable. Hence there is a need to address the impacts of climate change with appropriate adaptation and mitigation measures. IPCC defines **adaptation** as "*the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*" and **mitigation** as "*an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks*". Examples of adaptation measures include rainwater harvesting, land stabilization, flood control techniques, pond construction, shifting cultivation, introducing new variety of disease resistant crops, climate change awareness raising, climate induced disaster preparedness, etc. Whereas the mitigation measures include forest conservation and tree plantation programme, reducing consumption of energy-intensive products, switching to renewable forms of energy such as solar power, wind power, etc. These measures are intrinsically linked to sustainable development, as they reduce the risk to lives and livelihoods and increase the resilience[5] of communities to all hazards (UNISDR, 2008).

5 "Resilience is the amount of change a system can undergo and maintain the same function and structure while retaining options to develop in desired directions. Communities are resilient to climate change if they can withstand climate hazards and rebuild themselves". (LFP, 2010)

1.4 Rainwater harvesting as an adaptation method to climate change

Rainwater harvesting (RWH) is a simple and low cost technique which involves the capture and storage of rainwater from roofs and ground catchments for domestic, agricultural, industrial and environmental purposes. It has been practiced all around the world for years, and has become an important water source in many areas with significant rainfall. It is also a good option in areas where good quality fresh surface water or groundwater is lacking and can be very useful in rural settlements where gravity fed (piped) system is unable to supply water from the conventional source such as springs and streams.

RWH is now being used as an adaptation method in the face of changing climate and has many advantages in future climate change scenarios. IPCC (2007) considers rainwater harvesting as one of the adaptation option/strategy in water sector to climate change impacts. RWH can enhance the water availability at any specified location and time, increase groundwater levels and improve groundwater ecosystems (Mehta et al., 2012). The collected rainwater can be stored for direct use or can be recharged into the ground water which can be done through any suitable structures like dug wells, bore wells, recharge trenches, pits and ponds. These structures promote the percolation of rainwater into the ground instead of draining away from the surface. This helps in improving the quality of ground water, rising ground water levels as well as reducing the soil erosion as the surface runoff is reduced. The role of rainwater harvesting systems as sources of supplementary, back-up, or emergency water supply will become more important especially in view of increased climate variability and the possibility of greater frequencies of droughts and floods in many areas (UN-HABITAT, 2005).

More and more people all over the world are forced to live with limited and irregular access to fresh water resources; Nepal is no exception to this. WASH Sector Status Report (2011) reported that that the existing coverage of water and sanitation services in Nepal is approximately 80% and 43% respectively. Although the improved water supply coverage reported as 80%, less than half (43%) of the water supply schemes are not fully functional. Hence, about 5.5 million people do not have access to adequate improved water services and

16 million lack adequate sanitation facilities. Water supply by using piped water systems and pumped water system are often unfeasible in Nepal due to the difficult terrain and scattered settlements and also high initial and operation costs. This has tremendous implications for people's livelihoods in mountainous and rural areas of Nepal, especially for women and girls, who are forced to spend hours in fetching water to meet the basic water needs. In these areas, rainwater harvesting can be a useful technology and important source of water. Also, due to climate change, these areas are likely to be affected by drought and water scarcity. Hence, in areas with sufficient rainfall where different water systems are not feasible and adverse impacts of climate changes like drought and water scarcity are likely to be observed, RWH can be an important source of water and useful adaptation method to climate change impacts.

1.5 Organizations working in rainwater harvesting projects

Several governmental and non-governmental organizations in Nepal have been successfully promoting rainwater harvesting as a solution for water shortage as well as an adaptation measure to deal with climate change, especially in areas where other sources of water are (technically and/or economically) unfeasible. There are different organizations which have been working in RWH Projects like RWSSP-WN, Helvetas WARMP, NEWAH, BSP Nepal, NRCS, GWS, ENPHO, DWSS, RAIN Foundation, etc. These organizations are working to increase access to water through developing capacity for the collection of rainwater, to benefit vulnerable sectors of society, women and children in particular.

RWSSP-WN, working in 9 districts of Nepal, supports districts to implement WASH programme. It considers climate change as a crosscutting issue in its WASH programme. It is supporting the districts to implement both climate change adaptation and mitigation measures under WASH programme which include climate responsive water scheme construction (different technologies), rainwater harvesting, sanitation and hygiene practices improvement (water quality protection), multiple use systems (MUS) promotion, ecological sanitation (ECOSAN) and biogas promotion, improved cooking stoves (ICS) promotion, raised hand pumps and toilets in

Terai (flood protection), solar and wind water lifting, etc. (RWSSP-WN, 2012). RWSSP-WN has supported six rainwater water harvesting schemes (RWHS) in three districts: Pyuthan, Baglung and Syangja districts. Among them, Purkot RWHS of Kyakmi VDC in Syangja district and Swargadwari Khal RWHS in Pyuthan district were selected for the study.

1.6 Study area

1.6.1 Kyakmi VDC, Syangja District

Kyakmi VDC is one out of 60 VDCs, lying in the southern part of Syangja district (Fig1). To the east of this VDC lies Kihun VDC of Tanahun district and to west is Chinnebas and Sokham VDCs of Syangja district. In the north are parts of Chinnebas and Chitre VDCs of Syangja district and in the south is Gajarkot of Tanahun district and Sakhar of Syangja district. This VDC is situated at 500 to 1500 m above sea level, latitude between 27°96’ to 27°94’ N and longitude between 83°94’ to 83°96’ E and has total area of 43.04 km^2. This VDC is about 58 km away from district headquarter, Syangja. The average annual rainfall of this VDC is about 2,000 mm. (VWASH Plan, 2010)

According to the VWASH plan (2010), Kyakmi VDC had total population of 8,340 with total households of 1,253. But the CBS report (2011) shows a decrease in this figure and has indicated the total population of this VDC as 5,396 with 1,194 households. The majority of the population in the VDC is Janajatis (Magars). Thakuris (Sahis), Dalits, Brahmins, Chettris, Muslims etc. are also living in this VDC. Purkot rainwater harvesting schemes (RWHS) lies in Purkot, ward no. 1 of Kyakmi VDC. This area, Purkot has total households of 134 and total population of 987 with 502 males and 485 females. There are 16 spring sources and one pond in this area. (VWASH Plan, 2010)

SYANGJA DISTRICT MAP

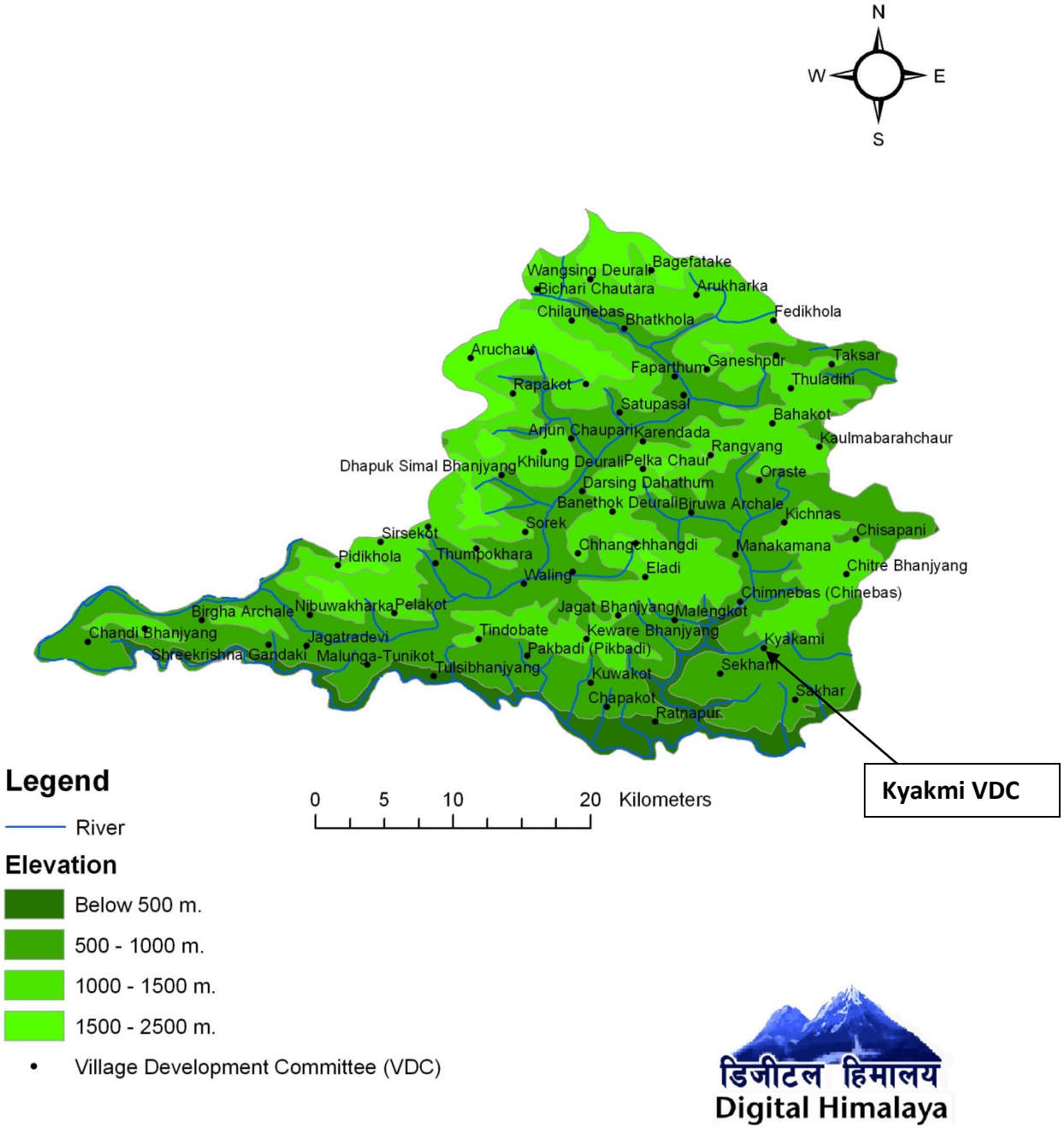


Fig.1 GIS Map of Syangja district showing the study area, Kyakmi VDC

1.6.2 Swargadwari Khal VDC, Pyuthan District

Swargadwari Khal VDC is one among 49 VDCs of Pyuthan district in Mid-Western Development Region of Nepal. It is located in the western part of Pyuthan district with total area of 4069.20 hectares (Fig. 3). To the east of this VDC lie Gothiwang and Bhingri VDCs of Pyuthan district, in the west is Masina VDC of Rolpa district, while in the north is Ghodagaon VDC of Rolpa district and Kochiwang VDC of Pyuthan district in the south. Swargadwari is one of the religious heritages of Nepal. This VDC is situated at 924 – 2200 m above sea level, between 28°07' to 28°11'05" N latitude and between 82°37' to 82°40'10'' E longitude. This VDC is about 39 km away from Khalanga, headquarter of Pyuthan district. In winter the average temperature of this VDC is 10°C and in summer its 25°C. The average annual rainfall of this VDC is about 2000 mm. (VWASH Plan, 2010)

Swargadwari Khal VDC has total population of 4,887 with 2,132 males and 2,755 females and total households of 1,058 (CBS Report, 2011). The majority of the population in this VDC is Magars (Adibasi/Janajati). Other castes like Brahmin, Chhetri, Kaami, Daamai, Tamang etc. are also living in this VDC. Land type ranges from high hills to flat lands. Most parts of this VDC are slopes, some are bare while some parts are forested and with villages. This VDC is rich in natural resources like water and forest as well as in religious and cultural heritages. Though it is rich in water resources, due to improper management of water resources, people are facing difficulties in drinking water and irrigation. According to the VWASH Plan (2010) of Swargadwari Khal VDC, there are 81 different water sources of which, some are large perennial streams while some are small streams. Also many of them are spring, well and spring fed streams.

PYUTHAN DISTRICT MAP

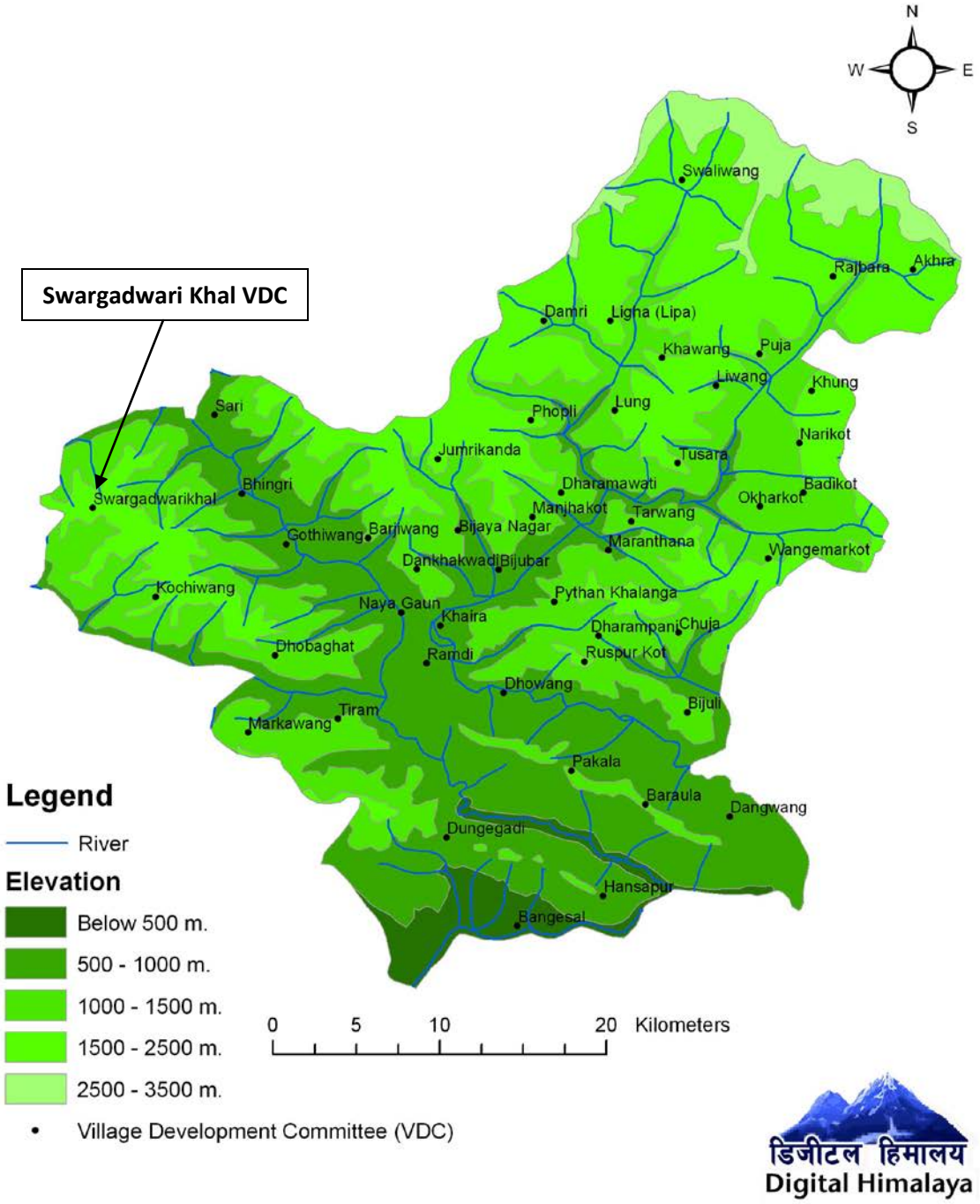


Fig.2 GIS Map of Pyuthan district showing the study area, Swargadwari Khal VDC

Table 1: Some details about Purkot Rainwater Harvesting Scheme and Swargadwari Khal Rainwater Harvesting Scheme (Source: MIS Data, RWSSP-WN)

	Purkot Rainwater Harvesting Scheme	Swargadwari Khal Rainwater Harvesting Scheme
➢ **Construction time**	7/07/2009 - 13/04/2011	21/02/2011 - 6/06/2012
➢ **No. of tanks constructed**	11	69
➢ **Type**	Ferrocement	Ferrocement
➢ **Capacity/Size**	20 m^3	6.5 m^3
➢ **Total Cost**	Rs 3,173,117.95	Rs 3,930,341
➢ **Community contribution (labour & cash)**	Rs 508,178.9 (Rs 476,417.69 & Rs 31,761.17)	Rs 713,122 (Rs 673,219 & Rs 39,903)
➢ **Beneficiaries**	51 Households	65 Households
➢ **Total population**	395 (198 Females & 197 Males)	395 (205 Females & 190 Males)
➢ **Per capita cost**	Rs 8,033.21	Rs 9,950.23
➢ **Users' committee members**	11 (5 Females & 6 Males)	5 (3 Females & 2 Males)
➢ **Operation & maintenance fund**	Rs 31,962	Rs 39,903
➢ **Village maintenance worker**	2 nos.	2 nos.

Purkot Rainwater Harvesting Scheme and Swargadwari Khal Rainwater Harvesting Scheme were supported by RWSSP-WN and District Development Committee/Government of Nepal and Finland Support. Purkot RWHS was coordinated by an NGO, Aapasi Sahayog Kendra (ASK) – Nepal of Syangja district while Swargadwari Khal RWHS was facilitated by Community Development Forum (CODEF) of Pyuthan district. In Purkot, the construction of the RWH tanks

was started on 17th June 2009 and completed on 13th April 2011 (Table 1). 11 ferrocement tanks of size 20 m^3 were installed which benefitted 51 households and one school. Purkot RWHS was Common Catchment Common Reservoir (CCCR) type of RWHS where 3 or 4 roof catchments were used and 5 – 6 households were using the common RWH system (Fig.3).

Fig.3 Community based RWH systems of size 20 m^3 with different catchments in Purkot, Kyakmi VDC, Syangja district

While in Swargadwari Khal, the construction of the RWH tanks was started on 21st February 2011 and completed on 6th June 2012 (Table 1). 69 ferrocement tanks of size 6.5 m^3 were installed which benefitted 65 households and one school. Swargadwari Khal RWHS was Individual Catchment Individual Reservoir (ICIR) type of RWHS where individual catchment was used and individual household was using the RWH system (Fig.4).



Fig.4 Individual RWH systems of size 6.5 m^3 in Swargadwari Khal VDC, Pyuthan district

Both of these schemes had beneficiaries' population of 395 with more female beneficiaries than male that is 198 females in Purkot and 205 females in Swargadwari Khal as given in table 1.

The total cost of RWH systems installation was higher in Swargadwari Khal than in Purkot since the number of tanks constructed in Swargadwari Khal was more than that of Purkot. The total cost of installation in Swargadwari Khal was Rs 3,930,341 with community contribution of Rs 713,122 in terms of labour (Rs 673,219) and cash (Rs 39,903). While in Purkot, the total cost of installation was Rs 3,176,117.95 with total community contribution of Rs 508,178.9 in terms of labour (Rs 476,417.69) and cash (Rs 31,761.17) as shown in table 1.

The per capita cost was also higher in Swargadwari Khal RWHS which was Rs 9,950.23 than that of Purkot which was Rs 8,033.21. But the number of members in users' committee was more in

Purkot i.e. 11 members with 5 females and 6 males than in Swargadwari Khal which had users' committee of 5 members with 3 females and 2 males. Both schemes have two maintenance workers and had operation and maintenance fund of Rs 31,962 in Purkot and Rs 39,903 in Swargadwari Khal which was collected during the construction period. These schemes were collecting water tariff of Rs 10 per household for operation and maintenance, making a total of Rs 510 per month in Purkot and Rs 690 per month in Swargadwari Khal. The maintenance workers were paid Rs 150 in Purkot but in Swargadwari Khal, the maintenance workers were not paid.

2. OBJECTIVES OF THE STUDY

The main objective of the study was to assess the Rainwater Harvesting Schemes of RWSSP – WN in Purkot, Kyakmi VDC of Syangja district and Swargadwari Khal VDC of Pyuthan district in the context of climate change impacts and community vulnerabilities. The study assessed how and why the schemes have been implemented, how sustainable they are and what are the major issues in the schemes. It also included the following objectives:

- Provide comparative basis for analyzing the findings within the schemes
- Analyze RWH as an adaptation method in the context of adverse impacts of climate change – water scarcity and drought
- Climate change awareness raising and focus group discussion in the communities to identify the local climatic hazard and the strategies adopted in dealing with the hazards

3. METHODOLOGY

The study was field-based and conducted using the following tools:

- Review of secondary data such as reports, papers, etc.
- Household survey to collect the relevant information using questionnaires
- Observations to cross-check information and complement the information gathered
- Climate change awareness raising and focus group discussion which included WUSC members as well as women groups

3.1 Primary data collection

For primary data collection, a field visit was made on 10 – 13th of Feb, 2013 to Purkot, Kyakmi VDC of Syangja district and 28th Feb – 4th Mar, 2013 to Swargadwari Khal VDC of Pyuthan district. Altogether, 40 households (20 households from each study area) were surveyed which were selected randomly in coordination with the district WASH Units. Male or female members in the household were interviewed using RWHS questionnaire. Observation of the RWHS was also done during the survey. Besides the survey, focus group discussion was conducted which

comprised members from WUSCs and women groups. Climate Change awareness raising was done followed by the discussion which helped the community to identify the local climatic hazard, its impacts and adaptation and mitigation measures.

Primary data were gathered through the following methods:

a. Household survey was conducted in 40 households to collect the information about the RWHS in the study areas. Also, observation of the RWH tanks was done during the survey. The questionnaire that was used to collect field data is attached in Annex 1.

b. Organizing focus group discussion: Focus group discussion was organized which comprised male and female members of the community, about 15 members in Purkot and 30 members in Swargadwari Khal. The first session of the discussion involved climate change awareness raising while the next session included discussion about the likely impacts of climatic hazards, adaptation and mitigation measures the community could adopt to reduce the impacts of such hazards.

3.2 Secondary Data collection

Secondary data were collected from research reports and papers.

3.3 Data processing and analysis

The data obtained from the survey were entered in Microsoft Excel 2007 and simple statistical tools were used for the analysis like bar charts and pie diagrams. Based on the analyzed data, the findings were obtained.

4. FINDINGS AND ANALYSIS

4.1 GENERAL FINDINGS

The total number of members in the households surveyed in Purkot was 93 with 42 males and 51 females. While in Swargadwari Khal, the total number of members in the households was 93, with 30 males and 57 females. In both study area there were more female members than male members. The average size of the household surveyed was 5, obtained by dividing the total number of members in the households surveyed (186) by total households surveyed (40). In the survey, 65% were female respondents while 35% were male respondents.

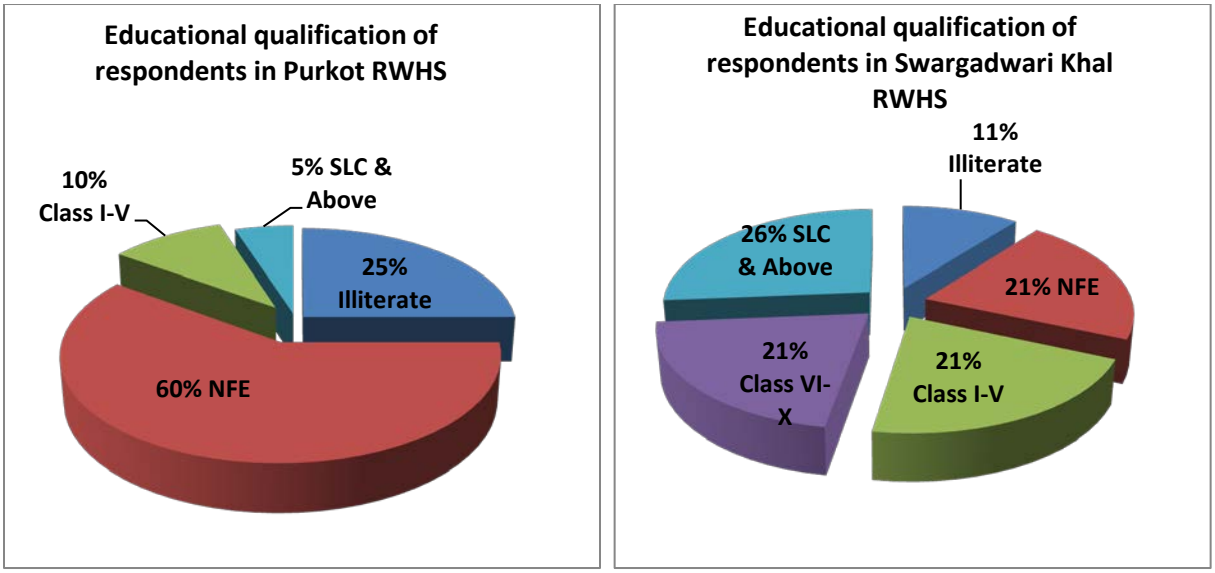


Fig.5 Educational qualification of the respondents in Purkot RWHS and Swargadwari Khal RWHS

Among the respondents in the survey, literacy rate was high in Swargadwari Khal VDC (89% literate) than in Purkot, Kyakmi VDC (75% literate). The remaining 11% and 25% of respondents were illiterate in the respective study area as shown in figure 5. 60% of respondents in Purkot RWHS had Non–Formal Education (NFE) while 21% of respondents had NFE in Swargadwari Khal. Though the respondents with NFE was higher in Purkot than in Swargadwari Khal, the number of respondents who had studied in Class I – X was in significant number in Swargadwari

Khal like 20% of the respondents had gone to Class VI-X, also, the same percentage had completed SLC and had higher education. But in Purkot, only 5% of the respondents were SLC & above. This could be the reason that more respondents in Swargadwari Khal (6 respondents) were aware of the concept of climate change and its impacts than in Purkot (only 2 respondents).

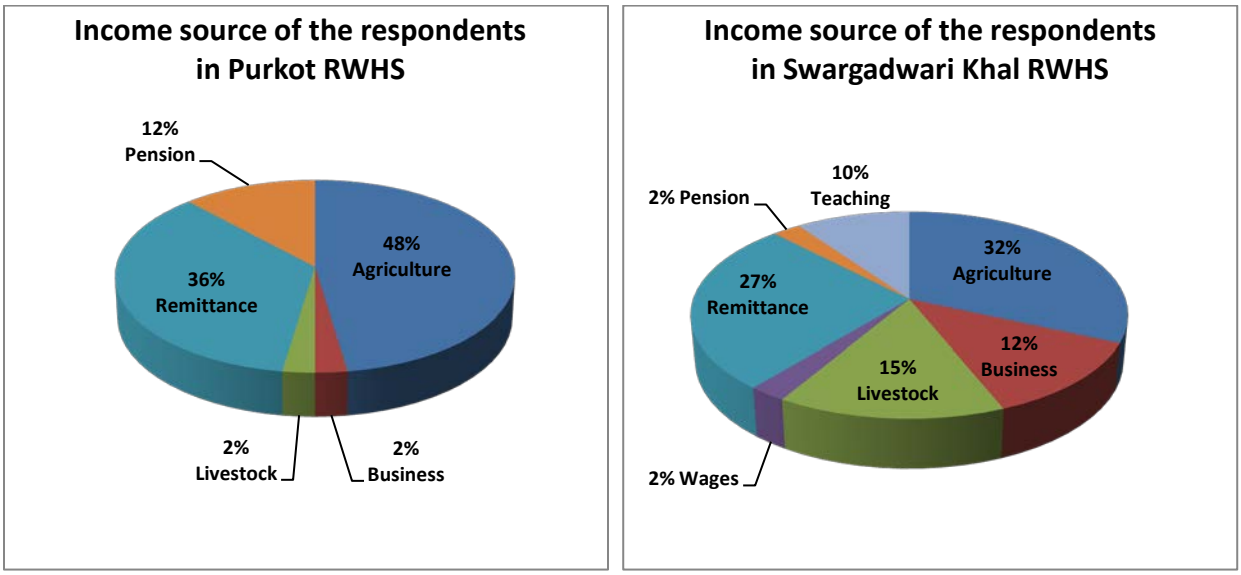


Fig.6 Income source of the respondents in Purkot RWHS and Swargadwari Khal RWHS

The main source of income was agriculture in both study areas, 48% and 32% of the respondents were engaged in agriculture in Purkot and Swargadwari Khal respectively as shown in figure 4. Since agriculture was the main income source, the respondents in the study areas were relating/expressing that the changing rainfall pattern had impacts on the agricultural production. Remittance was the second biggest source of income with 36% and 27% of the respondents' income source as remittance in Purkot and Swargadwari Khal respectively. Five households in Swargadwari Khal were also involved in business; among them one was also running a hotel. Teaching was one of the occupations followed by four households in Swargadwari Khal and these respondents were aware of climate change and its impacts.

4.1.1 Before the installation of RWHS

Before the installation of RWHS, the primary source of water in Purkot was spring source and water was available in the source throughout the year (Fig. 7). The respondents in Purkot mentioned that it would take more than 45 minutes or 1 hour for a roundtrip to fetch water from the spring source which was located down the hill. On average, respondents in this area used to make 5 – 6 trips per day to the source depending on the family size, but the fetched water was not sufficient enough to meet all the water needs of the households. Before the spring source improvement, older people mentioned that they often had to wait for their turn to fill their vessels and it would take more than 2 hours for a roundtrip. So, they had to rush to the source for water collection, before dawn, lighting fire on the bamboo sticks. But with source improvement they sometime have to wait for their turn to fetch water. Mainly, women were responsible for water collection. Men, girls and boys were also involved in water collection.

Fig.7 Spring Source in Purkot

The primary source of water in Swargadwari Khal was also a spring source before the installation of RWHS (Fig. 8). Water was available throughout the year in the source but the discharge was very low during dry period, Chaitra – Jestha. So, the community people were also using river water which was located down the hill and it would take more than 1 hour for water collection. On average, respondents in this area used to make 7 – 8 trips per day to the source but the fetched water was not sufficient enough to meet all the water needs of the households.

In this area too, women were primarily responsible for water collection (Fig. 9). Men, girls and boys were also involved in water collection.

Fig. 8 Spring Source in Swargadwari Khal

Fig. 9 Women fetching water from the spring source

Out of 20 households surveyed in Purkot, four households said that accidents used to happen often while the remaining households told that it would happen sometimes. Quarrel while fetching water was a rare incident in the community. Whereas in Swargadwari Khal, 12 respondents expressed that accidents used to happen often and the rest told that it would happen sometimes. Most of the respondents in Swargadwari Khal, 17 of them said that often there used to be quarreling for scarce water.

While asked for their opinion towards RWH, 15 respondents in Purkot and 12 respondents in Swargadwari Khal that is 27 respondents in total expressed that they had always liked the idea of rainwater harvesting (Fig. 8) as they believed by this technology would make their life easier. The remaining, 5 and 8 respondents in Purkot and Swargadwari Khal respectively, a total of 13, mentioned that they didn't like the idea of rainwater harvesting before but now they liked it. Some of the respondents told that they had seen the system in the neighboring villages and wanted to install the same in their household.

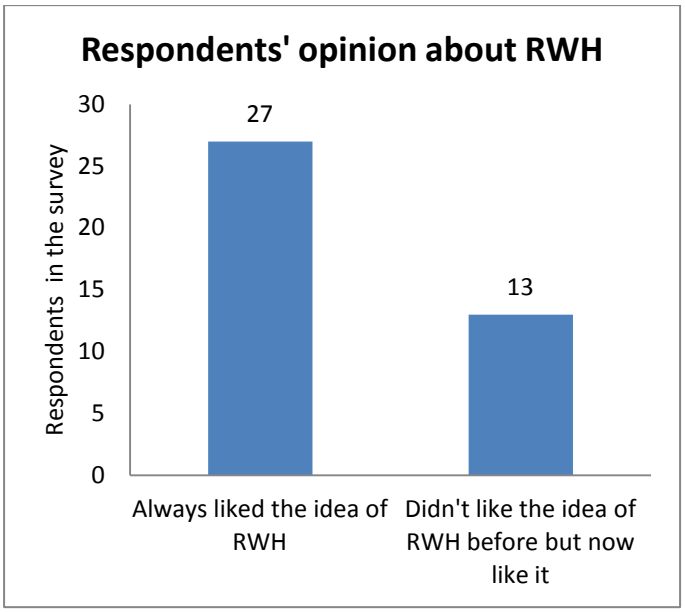


Fig. 10 Respondents' opinion about RWH in the study areas

4.1.2 After the installation of RWHS

After the installation of RWHS, the households in both schemes had been relieved. Respondents expressed that their life was very hard before but now life had become much easier. There was easy access to water, so they did not have to rush to the source very early in the morning for water collection. Households had been using the schemes for about 1.5 – 2 years. They were mostly using rainwater during wet season (June to September) and with the start of dry period, they would use the rainwater in controlled way like locking their taps and opening them early in the morning for water collection. People in these communities were still dependent on the previous source for water. They used to make 5 – 6 trips per day to the

source before but now that has decreased to 3 – 4 trips in a day. The average water consumption has increased to 60 liter per capita in both schemes after its implementation (MIS Data).

In Purkot, the community had recently installed a solar lifting system for their spring source through the support of DDC, RWSSP-WN, AEPC (Alternative Energy Promotion Center) and an NGO from Palpa district, REDA (Rural Economic Development Association). They have been using that system for nearly 2 months. So, out of 10 tanks constructed for households in this area, only 3 of them had rainwater and the remaining tanks had water from the lifting system. They were storing rainwater to be used during the dry period (Chaitra, Baisakh & Jestha), during any ceremonies in the village like marriage, funeral ceremonies, etc. and also if the existing solar lifting system becomes dysfunctional. The community people expressed that the cost of installing this lifting system was very high and they were not sure whether this system would be sustainable.

Fig.11 Solar lifting system installed in Purkot and community people fetching water from this system

Since, the RWH tanks were used for storing the solar lifted water from the spring source; there was difficulty in assessing the RWHS in Purkot and comparing it with that of Swargadwari Khal. So the comparisons were made based on the experience of using rainwater by Purkot community before the installation of solar lift system as they were not currently using rainwater but using water from spring source.

4.2 RAINWATER USE, QUALITY AND BENEFITS

4.2.1 Rainwater use

Most of the households surveyed in Purkot RWHS, 19 out of 20 households used rainwater for livestock and washing/cleaning purposes (Fig. 12). Very few households used rainwater for drinking and cooking purposes. Most of the households in Purkot used the spring source for drinking and cooking as they were habituated to drinking water from spring source and since the RWH systems were community based, they had the perception that the system was not cleaned well and the rainwater was not safe enough to drink. Also, they had intalled the solar lifting system from where the spring water was easily available and hence were using this water for drinking and cooking purpose. But in Swargadwari Khal RWHS, most of the households, 15 out of 20 households were using rainwater for drinking and cooking purpose as they considered the rainwater safe since they had individual RWH system which were cleaned regularly by themselves. Also they did not have other system like in Purkot, so they had to depend on rainwater for drinking, cooking, livestock and washing/cleaning purposes. Few households in Purkot re-used the rainwater for kitchen gardening while a significant number of households were reusing rainwater for kitchen gardening in Swargadwari Khal (Fig. 12). Rainwater was also used for latrine in both study areas.

In a similar case study which was supported by RWSSP-WN and conducted by Dahal et al. (2010) of the RWH schemes implemented in Syangja and Tanahun districts, it was reported that only 22.77% of the total households surveyed (101 households) were using rainwater for drinking purpose although 79.21% of the respondents stated that rainwater was clean. But in this study, it was found that about 52.5% of the total households surveyed (40 households) were drinking rainwater with 50% of the total respondents mentioning that the rainwater was safe to drink. However, the reasons for not using rainwater for drinking purpose were similar in both studies that is habituated to previous water sources and rainwater not safe enough for drinking due to lack of cleanliness. 52.4% of the households who were using rainwater for drinking purpose were found boiling rainwater before drinking and the remaining households

were drinking rainwater without any treatment. Only one household strained rainwater through cloth and one household practiced SODIS before using rainwater for drinking in Swargadwari Khal.

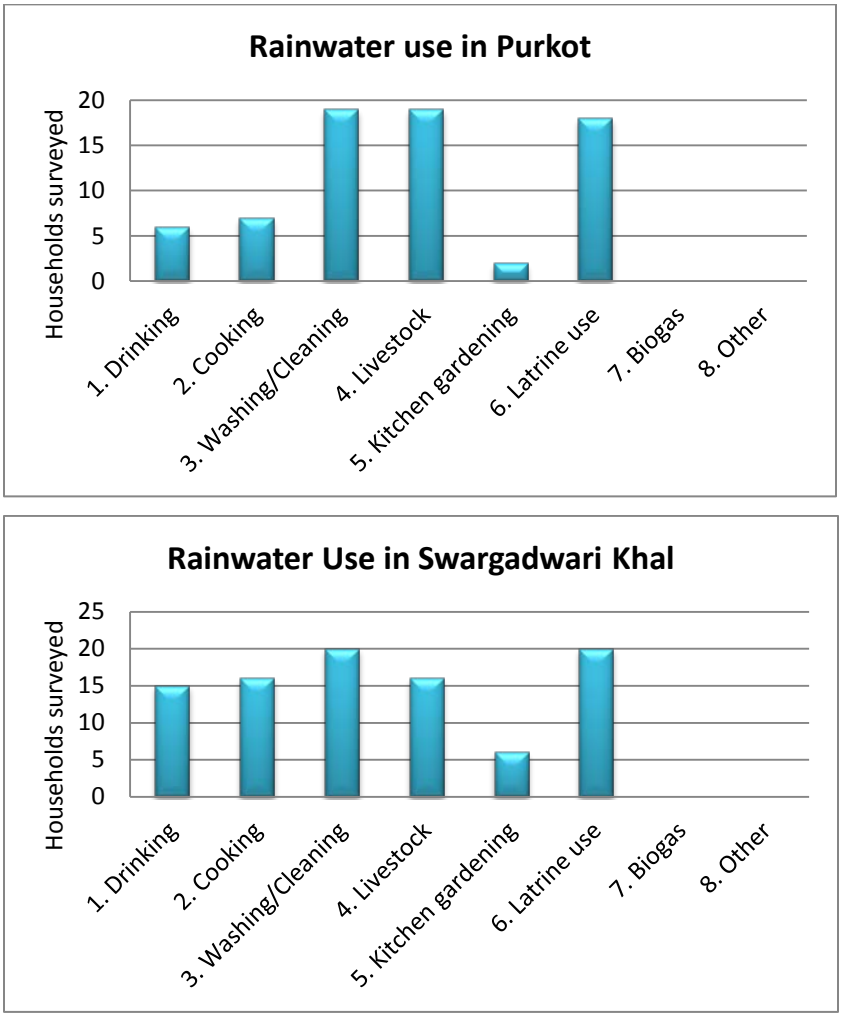
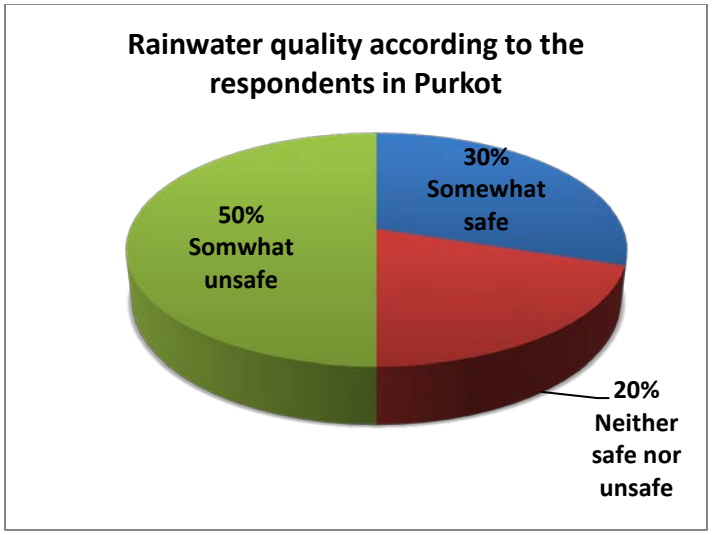


Fig.12 Rainwater Use in Purkot RWHS and Swargadwari Khal RWHS

4.2.2 Rainwater quality

70% of the respondents in the Swargadwari Khal expressed that the quality of rainwater was somewhat safe while only 30% in Purkot mentioned that it was somewhat safe as shown in the figure 13. So most of the households in Swargadwari Khal were using rainwater for drinking and cooking purposes. However, in Purkot, 50% respondents viewed the rainwater quality as

somewhat unsafe and were not using rainwater for drinking and cooking purpose. The reason for rainwater being unsafe was dust particles, insects, leaves, etc would enter easily on the tank and contaminate the rainwater as the tanks didn't have filtering nets on the inlet. Some households also mentioned that they didn't like the taste of rainwater and were not using it for drinking purpose.



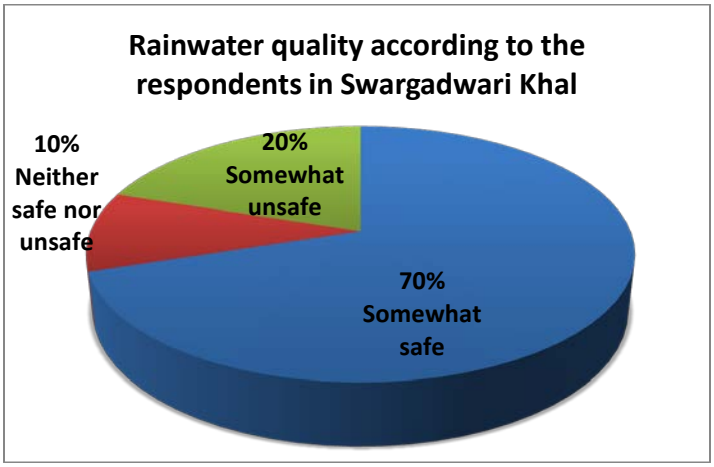


Fig.13 Rainwater Quality according to the respondents in the survey

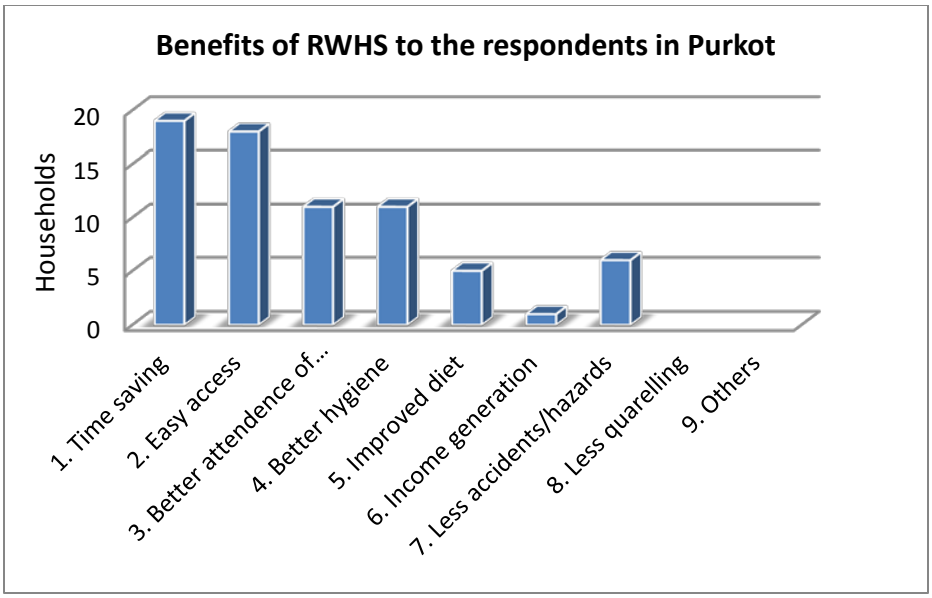
For water quality testing, six water samples were taken in Coliforms P/A Test Vials, two from Purkot RWHS and four from Swargadwari Khal RWHS. Of two water samples tested in Purkot RWHS, no coliforms were present in the samples. But in Swargadwari Khal RWHS, out of four water samples, one water sample contained coliforms indicating the feacal pollution and water not fit for drinking. In the previous study done in Syangja and Tanahun district, 65% of the

water samples tested (20 samples) for water quality contained coliforms but in this study it was found that one out of six water samples i.e. 16.67% of the water samples contained coliforms. The contamination may be due to droppings of birds and insects, dust particles etc. on the catchment area.

4.2.3 Rainwater benefits

With the installation of RWHS, the households had received benefits from using this system such as time saving, easy access to water, better attendance of children in school, better hygiene, improved diet, income generation, less accidents/hazards, less quarrelling, etc. (Fig. 14). Similar benefits were found in the previous study of RWHS in Syangja and Tanahun districts conducted by Dahal et al. (2010). Most of the households surveyed viewed time saving and easy access to water as the main benefits of RWHS. The drudgery of fetching water had reduced significantly and the households had been relieved. The MIS Data of RWSSP-WN showed the average time saved per households which was 20 minutes in Purkot and 40 minutes in Swargadwari Khal.

Better hygiene was one of the important benefits the households received through the installation of RWHS (Fig. 15). With the availability of rainwater easily in the households, they were able to utilize it for personal hygiene and cleanliness of surroundings. In Swargadwari Khal, improved diet was also an important benefit as a result of using rainwater for kitchen gardening (Fig. 16). One household in Swargadwari Khal was involved in business; running a hotel. This household expressed that RWH system had been very useful to them in doing so but mentioned that the quantity was not sufficient enough for them. Few households surveyed were also involved in income generation activities like rearing livestock, vegetable farming, etc.



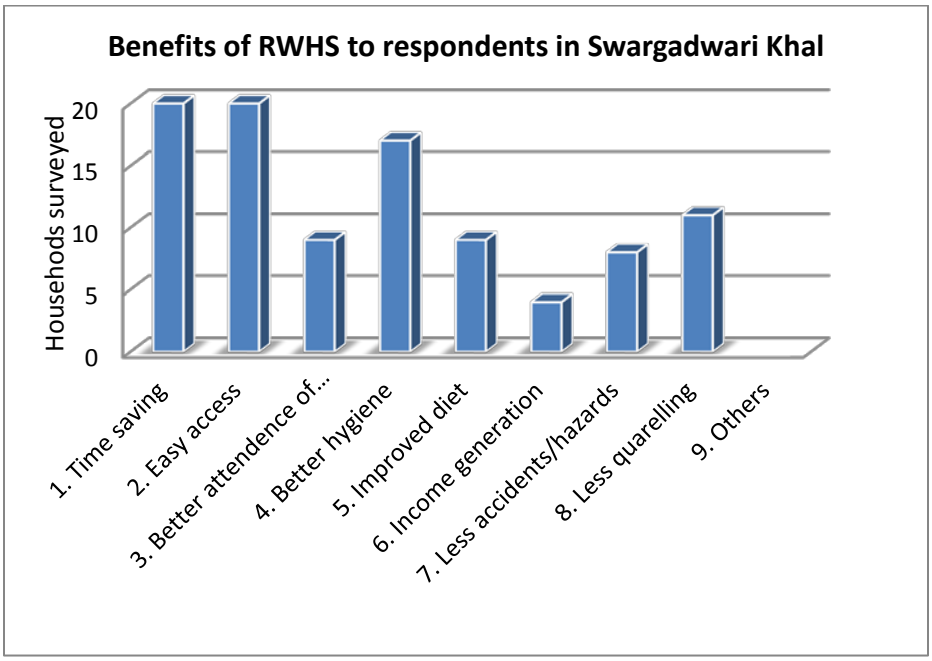


Fig.14 Benefits of RWHS to the respondents in the survey

Fig.15 A woman washing her clothes with rainwater in Swargadwari Khal VDC

Fig.16 Reusing rainwater for kitchen gardening in Swargadwari Khal and Purkot

"Life was very hard before because water wasn't easily available. I remember those days when we woke up very early in the morning and rush to the spring source without even fearing of darkness, by lighting the bamboo sticks and sometimes, even falling down with the gagris of water on the back while climbing up the hill. Because of this difficulty, many people left this village. But now, the situation is very different. We have been relieved by the installation of RWH system in our community and thankful to those organizations that helped us with RWH technology. Each and every household have easy access to water. People who had once left this place have returned now and you can see they are building houses here."

Mrs. Jhuma Sahi, Social mobilizer in Purkot

"Rainwater harvesting has benefitted us in many ways. We had easy access to water; our time has been saved which we are utilizing in different household activities like cleaning our houses, taking care of our children, kitchen gardening, etc. I've started growing vegetables by re-using rainwater. This has improved the diet of my family and also my neighbors whom I provide fresh vegetables when there is enough production. Not only these benefits, we had achieved another benefit by installing RWHS, that is construction of road which was done while transporting the materials for RWH tank construction. Life has become easier than before."

Mr. Basanta Bahadur Khadka, Teacher in Swargadwari Khal

4.3 LEVEL OF SATISFACTION WITH RWHS

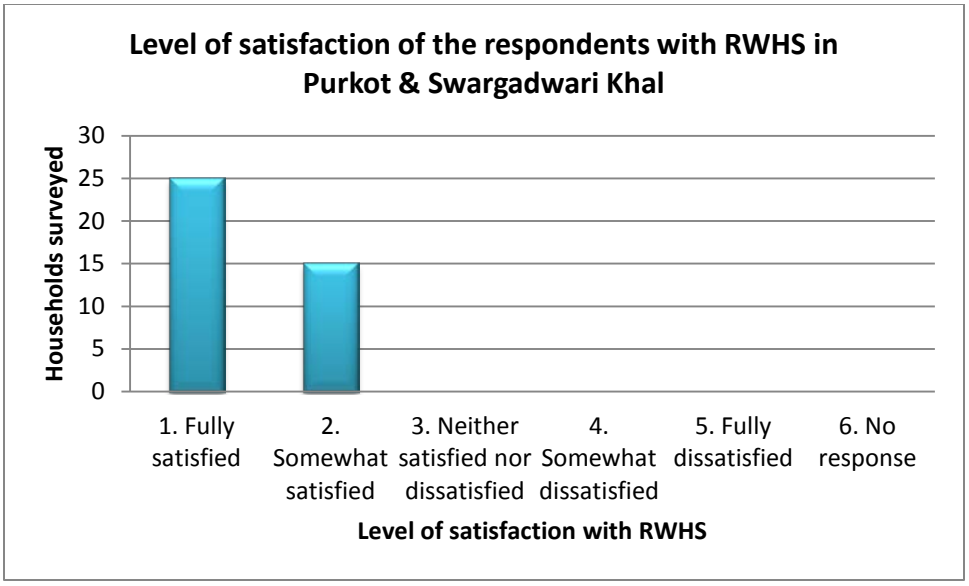


Fig.17 Level of satisfaction of the respondents with RWHS in Purkot and Swargadwari Khal

All the RWH systems were well maintained and working very well. Most of the respondents in the survey were satisfied with their RWH systems with no households dissatisfied with the system. 62.5% of the total respondents expressed that they were fully satisfied with the RWH systems as they had easy access to water now which they hadn't before. While, 37.5% of the total respondents mentioned that they were somewhat satisfied with their RWHS. The major inconvenience with the system was insufficient capacity of the tank, with 35% of the respondents in both study areas mentioning about it. So, the community people still had to depend on the spring source and make controlled use of the rainwater with the start of dry periods. This could be one of the reasons that community people in Purkot had installed the solar lifting system which would ease the water availability.

4.4 PERCEIVED CHANGES IN WATER AVAILABILITY

Water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change (IPCC, 2007). Practical Action (2010) reported that with climate change, the water sources in the middle hills of Nepal have been affected with reported events of drought and drying up of spring sources. The households interviewed in the survey had observed these changes like drought and irregular rainfall in recent years which have changed the water availability in their communities.

Of 40 households interviewed in the study areas, 28 respondents in the survey mentioned that they have observed the changes in the environment in the last 10 years. Half of the respondents indicated that the event observed which hadn't occurred before in the community was irregular rainfall. 15 respondents mentioned that drought was occurring in their community while 8 respondents told that there was increase in temperature in recent years, especially high summer temperature. The households pointed out that these events had resulted in less water availability and ultimately affected the agricultural activities in the community.

4.5 PERCEIVED CHANGES IN PRECIPITATION PATTERN IN THE COMMUNITY

Changes in the annual rainfall cycle, intense rainfall and longer droughts have been observed in Nepal and the timing and duration of rainfall is changing (Nepal Climate Change Policy, 2011). The respondents in the survey had experienced these changes in precipitation such as delayed timing of precipitation, decreased winter precipitation and increased monsoon precipitation in their community in the last 10 years. 90% of the total respondents mentioned that they had observed changes in the precipitation pattern in the community. 65% of the respondents perceived that the timing of the precipitation was delayed. As most of the households in both study areas were involved in agricultural activities, it was easy for them to remember or notice the delayed timing of precipitation. However, for changes in annual precipitation or winter and monsoon precipitation patterns, few respondents were noticing changes such as 40% of the

respondents expressed that there's decrease in winter precipitation while 30% mentioned that there's decrease in annual precipitation. Only 12.5% of the respondents perceived that there's increased monsoon precipitation. This may be due to lack of awareness that the changes in precipitation pattern are being observed as a result of climate change. The respondents considered these changes to be natural phenomena.

NAPA (2010) reported that monsoon precipitation shows general declining trends in the mid-western and southern parts of western Nepal while in the rest of the country, monsoon precipitation has generally increased. In case of Swargadwari Khal VDC which lies in the mid-western Nepal, the observed change according to NAPA is decreasing monsoon but only 10% of the respondents mentioned that they had experienced decreased monsoon in this area. While in Purkot lying in the western Nepal, where monsoon precipitation according to NAPA is increasing, only 10% of the respondents had experienced increasing monsoon.

Winter precipitation trends show overall increasing trends except the northern part of mid-western, western and eastern Nepal (NAPA, 2010). 5% of the respondents in Swargadwari Khal were experiencing increased winter precipitation while no respondents in Purkot were experiencing it.

Practical Action (2009) reported that western development region represented increasing annual precipitation while most of the mid-western development region observed a decreasing annual precipitation trend. For Swargadwari Khal lying in the mid-western development region, the observed change in annual precipitation is decreasing according to 35% of the respondents in this area. In Purkot, which lies in the western development region, none respondents mentioned that the annual precipitation was increasing. The respondents in both study areas were observing changes in precipitation pattern but they were not aware of the causes behind these changes. They simply perceived these changes as natural processes.

4.5.1 Impacts of changes in the precipitation pattern in the community

Most of the respondent, 87.5% in the survey perceived that changes in the precipitation pattern will have impacts in their community such as less water availability in their RWH system or other sources and damage to the system. The major threats of climate change experienced in WASH sector are the depletion of surface and groundwater sources, water quality pollution and damaging the scheme structures due to floods, landslides, and erosion (RWSSP-WN, 2012). Out of 40, 29 respondents told that there will be less water available in the RWH tanks, 30 said that spring sources will be drying and there will be less water available in the other sources too. Only 2 respondents mentioned that there may be damage to the system if there's intense rainfall or strong wind, displacing the gutters of the RWHS.

Very few respondents were aware of the concept of climate change. In Purkot, only 2 respondents were aware of climate change while in Swargadwari Khal, 6 respondents were aware of it as more respondents were literate in this area than Purkot. These respondents related the impacts of climate change with water scarcity, drought and drying of the spring sources. Although few respondents were aware of climate change and its impacts, most of the households had experienced the changes in climate like more drought, irregular rainfall, hotter days, etc. Most of the households, 95% of the respondents (38 out of 40 HHs) interviewed expressed that RWH would be a useful method in cases of drought and water scarcity as they could store rainwater in their tank and use it.

4.6 SUSTAINABILITY OF RWHS

The RWH systems were well maintained in both study areas; only 2 or 3 minor repairing was done by village maintenance worker. The RWH tanks were cleaned annually in both places. In Purkot, since the RWH system was community based and solar lifting system was installed, they were cleaning their tanks often, every two months. The respondents perceived that the cost involved in repairing or maintaining the system is somewhat low with 77.5% of the respondents indicating that; and 12.5% of the respondents expressed that the cost for repairing or

maintaining is somewhat high especially for big repairing. The respondents were able to use rainwater for 3 months after the start of dry period, during the months of Chaitra, Baisakh & Jestha. The existing capacity of the RWH tank was sufficient only in the case of controlled use of rainwater. 72.5% of the total respondents expressed that the existing capacity of the tank is not sufficient enough to meet the water demand of the households during dry periods so they were using rainwater in a controlled way. The households were managing the use of rainwater by using it for drinking and cooking purpose and water from other source for other purposes like livestock, washing and cleaning, etc.

In the previous study of RWHS in Syangja and Tanahun districts, about 70% of the users in Tanahun were not satisfied with jar size of 2m^3 while in Syangja, most of the users were relatively satisfied with the size of the jar which was 10 to 20 m^3 as they could store large quantity of rainwater for use in dry period. In this study too, the respondents were not satisfied with the size of jar; individual RWH system of size 6.5 m^3 in Swargadwari Khal and community based RWH system of size 20 m^3 in Purkot which was used by 5 – 6 households.

According to WASH Sector Status Report (2011), the key factors that limit sustainability are reliance on capital hand-outs from government and donors, institutional weaknesses, lack of attention to environmental impacts, weak operation & maintenance and inadequate investment in rehabilitation. These limiting factors of sustainability were absent in the study areas as the households were maintaining their RWH systems well. They were regularly cleaning their tanks and repairing & maintenance were done by the maintenance workers. They believed that the cost involved in repair and maintenance was somewhat low. With regular operation and maintenance, the respondents in both study areas viewed the RWH system as a sustainable one.

4.7 CLIMATE CHANGE AWARENESS RAISING AND FOCUS GROUP DISCUSSION

Climate change awareness raising during focus group discussion was very helpful to the community for learning about climate change, its impacts and mitigation & adaptation measures to reduce its impacts. During the discussion, the community people in both study areas mentioned that the drying spring source was the local climate hazards and women were more vulnerable to its impact as they were the ones primarily responsible for water collection. In order to cope with the adverse impacts of climate change – drought and water scarcity, the community was planning to construct RWH recharge pond in their community which would also help in replenishing the drying spring source. Tree plantation programme was also one the coping strategies adopted. In Swargadwari Khal, the community had started constructing a recharge pond at top of the hill but due to lack of fund, the construction work had not progressed further. The community was approaching for some fund for its completion.

Fig.18 Climate change awareness raising and focus group discussion in Purkot

Fig.19 Climate change awareness raising and focus group discussion in Swargadwari Khal VDC

Fig.20 RWH Recharge Pond construction in Swargadwari Khal

Fig.21 A man filling water vessel from a pond in Swargadwari Khal

4.8 MAJOR FINDINGS ON OBSERVATION

- In Purkot, observed two/three RWH tanks had cracks in their surface. This was because the tanks were constructed during dry period when there was less availability of water for curing process. Also some HDPE pipes of the RWH system were exposed on the ground surface and had some leakages.

Fig.22 Cracks present on the surface of RWHS and HDPE pipe exposed on the ground surface with some leakage in Purkot

- In Purkot, institutional RWH system was found to be well maintained but in Swargadwari Khal, the institutional RWH systems were not well maintained and had water leakages as shown in figure 25.

Fig.23 Well maintained institutional RWH system in Purkot

Fig.24 RWH system in VDC Office of Swargadwari Khal

Fig.25 Water leaking from RWH system in a school in Swargadwari Khal

5. CONCLUSIONS

A case study on the Rainwater Harvesting Schemes of RWSSP-WN in Purkot of Syangja district and Swargadwari Khal of Pyuthan district was done during February and March, 2013 in order to assess these schemes in the context of climate change impacts – drought and water scarcity. Based on this study, following conclusions and recommendations were made:

- With the installation of RWHS in these areas, the drudgery of fetching water had reduced significantly in both study areas and the communities had received benefits such as time saving, easy access to water, better attendance of children to school, better hygiene, improved diet, etc.
- The RWH systems were well maintained and working well in Swargadwari Khal. Although the RWH system in Purkot was not purely RWH system as the community were using the RWH tanks for storing solar lifted water from the spring source, the tanks were well maintained and working well.
- The major inconvenience with the RWH systems was the insufficient capacity of the tank so the communities still had to depend on spring source and make controlled use of rain water with the start of dry periods. Hence the appropriate size of the tank should be considered in the planning process of RWHS. Domènech Pretus (2009) recommended that a RWH system of 10 m^3 is sufficient to provide a family with water for drinking and other small domestic uses for a whole year (based upon 5 liters per person per day).
- Also the construction time should be taken into consideration during the planning process. As in case of Purkot, the construction of RWH systems was completed after the start of dry period, when there was less water available for curing process because of which there were cracks on the surface of the tanks.
- The households interviewed perceived drought and irregular rainfall as the observed changes in recent years. They had also experienced changes in precipitation such as delayed timing of precipitation, decreased winter precipitation and increased monsoon precipitation in the last 10 years. These changes had affected the water availability in their communities resulting in less water availability in the RWH system and other

sources. But they were not aware that these changes could be happening as a result of climate change.

- Climate change awareness raising during focus group discussion was very helpful to the community in learning about climate change, its impacts and mitigation & adaptation measures to reduce its impacts. Few respondents in the study areas were aware of the concept of climate change and its impacts. Hence, such awareness raising should be done in every community so that people would be able to understand that the changes they are experiencing are the impacts of climate change and adopt various adaptation and mitigation measures to cope with climate change impacts.
- With climate change, droughts are likely to occur, affecting the water availability – drying up of spring sources and resulting in water scarcity. Adaptation methods like rainwater harvesting, recharge pond construction, etc. would make the community less vulnerable to drought. In both study areas, the local climatic hazard identified was drought and in order to adapt with it, the communities were planning to construct RWH recharge pond which would help in replenishing the drying spring source. Most of the respondents in the survey viewed RWH as a useful adaptation method in cases of drought and drying spring sources as rainwater is stored in the tank and available for use. In addition to RWH systems, other systems like solar lifting system as in case of Purkot could be an alternative method to adapt with the changing climate which has resulted in drought & water scarcity and make the community less vulnerable to its impacts.
- Regular monitoring of the completed RWHS should be done in order to know how the schemes are working, how the communities are benefitting from the schemes and the issues related to the schemes. This will help in identifying any problems within the schemes and propose solutions to the problems thereby ensuring the sustainability of the system.

REFERENCES

Baidya, S.K., M.L. Shrestha and M.M. Sheikh. (2008). Trends in daily climatic extremes of temperature and precipitation in Nepal. Journal of Hydrology and Meteorology Vol. 5, No. 1, SOHAM-Nepal, Kathmandu

Central Bureau of Statistics. (2011). National Population and Housing Census 2011 (Village Development Committee/Municipality. Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics, Kathmandu, Nepal

Dahal R., Ban J., Makaju S., Shrestha R. S. and Dwa N. (2010). Rainwater Harvesting (RWH) in Nepal. A case study on social acceptability and performance evaluation of RWH schemes implemented in Syangja and Tanahun districts. Institute of Engineering in Western Regional Campus, Pokhara, Nepal

IPCC. (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press

IPCC. (2008). Climate Change and Water. Technical Paper on the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva

LFP. (2010). Participatory Tools and Techniques for Assessing Climate Change Impacts and Exploring Adaptation Options. A Community Based Tool Kit for Practitioners, Livelihood and Forestry Programme

Mehta, K. R. and Shah, C. S. (2012). Impacts of Climate Change on Water Availability and Food Security of Nepal, Hydro Nepal, Special Issue, April 2012

Ministry of Population and Environment. (2004). Initial National Communication to the United Nations Framework Convention on Climate Change. Singha Durbar, Kathmandu. Government of Nepal, Ministry of Population and Environment

Ministry of Environment. (2010). National Adaptation Programme of Action to Climate Change, Kathmandu, Nepal

Nepal Climate Change Policy. (2011). Government of Nepal, Ministry of Science, Technology and Environment, Kathmandu, Nepal

RWSSP-WN. (2012). Draft Concept Paper on Integration of Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) Approach in District WASH Program

UN-HABITAT. (2005). Blue Drop Series on Rainwater Harvesting and Utilization, Book 2: Beneficiaries and Capacity builders

Practical Action. (2009). Temporal and Spatial Variability of Climate Change over Nepal (1976 – 2005). Practical Action, Kathmandu Office

Practical Action. (2010). Impact of Climate Change: Voices of the People. Practical Action, Kathmandu Office

Domènech Pretus L. (2009). Field Study on Feasibility of Rainwater Harvesting for Human Consumption and for Livelihood Enhancement in Rural Nepal.

Thapa Amrita. (2010). Climate Change Training Manual. An Easy Guide for Teachers. Climate Change Network Nepal

UNISDR. 2008. Climate Change and Disaster Risk Reduction, Breifing Note 01, Geneva, Switzerland

VWASH Plan of Kyakmi VDC. (2010). Water, Sanitation and Hygiene Plan, Kyakmi VDC, Syangja district, Nepal.

VWASH Plan of Swargadwari Khal VDC. (2010). Water, Sanitation and Hygiene Plan, Swargadwari Khal VDC, Pyuthan district, Nepal

WASH Sector Status Report. (2011). Government of Nepal, Ministry of Physical Planning and Works, Water Supply and Sanitation Division, Sector Efficiency and Improvement Unit, Kathmandu, Nepal

Internet Sources:

- www.digitalhimalaya.com/collections/maps/nepalmaps Accessed on 22nd March, 2013
- www.climatechange.gc.ca Accessed on 4th April, 2013

ANNEXES

Rainwater Harvesting Schemes – Household Survey Questionnaire

District…….. VDC…….. Ward No…….

Name of interviewee: ……. Gender: M/F

Date:

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1. General Information:

1.1. Household members

Members	Ages
Male	
Female	

1.2. Educational Qualification of respondent:

- ☐ Illiterate
- ☐ NFE
- ☐ Class I-V
- ☐ Class VI-X
- ☐ SLC & Above

1.3. What are the main sources of income of your household?

- ☐ Agriculture
- ☐ Business
- ☐ Livestock
- ☐ Wages
- ☐ Remittance
- ☐ Pension

2. Water Use, Water Quality and Benefits of RWH

Before the installation of RWH

2.1 Before the installation of RWHS, what was the primary source of water?

- ☐ Piped water / gravity flow system
- ☐ Water from spring
- ☐ Surface water (river, stream, etc)
- ☐ Other _____

2.2 Water availability in that source (in months):

_____

2.3 How long did it take for a roundtrip to fetch water from the source?

- ☐ Less than 15 min
- ☐ 15-45 min
- ☐ More than 45 min

2.4 How many trips to the water source were made in a day?

_____

2.5 Person responsible for water collection:

- ☐ Women
- ☐ Men
- ☐ Girls
- ☐ Boys

2.6 Did you have to wait for your turn to collect water at the source?

☐ Always ☐ Mostly ☐ Some time N☐

2.7 Were there any accidents/ hazards while fetching the water from the source?

☐ Often ☐ Sometimes ☐ Never

2.8 Was there quarrelling while fetching water when there's water scarcity?

☐ Often ☐ Sometimes ☐ Never

2.9 What was your opinion towards rainwater harvesting before the installation of RWHS?

- ☐ I didn't like the idea of rainwater harvesting before but now I like it.
- ☐ I've always liked it.
- ☐ Others _____

<u>After the installation of RWHS</u>

2.10 How many years or months have you been using the RWHS?

_____

2.11 How much was your contribution in installing the RWHS?

Rs _____

2.12 During which months do you mostly use rainwater?

_____

2.13 Do you use other sources of water besides rainwater?

- ☐ Yes
- ☐ No

a. If yes, then which source do you use?

- ☐ Spring source
- ☐ Surface water (river, stream, etc.)
- ☐ Others _____

b. Is this source the previous one you were using before RWHS installation?

- ☐ Yes
- ☐ No

c. If no then, How long does it take to make a round trip to fetch water from this source?

_____

d. How many trips do you make in a day?_____

e. During which months do you use water from this source? _____

2.14 For what purposes do you use water from RWHS and other sources during monsoon and other seasons?

Source / Uses	Rainwater Harvesting System		Other water sources	
	Monsoon	**Other seasons**	**Monsoon**	**Other seasons**
Drinking				
Cooking				
Washing/Cleaning				
Livestock				
Kitchen gardening				
Latrine use				
Biogas				
Other				

2.15 According to you what is the quality of rainwater and other sources?

Quality / Source	Very safe	Somewhat safe	Neither safe nor unsafe	Somewhat unsafe	Very unsafe	No response
Rainwater						
Other sources						

2.16 Water treatment- before drinking

Method / Source	No treatment	Boiling	Filtration	Strain through a cloth	SODIS	Chlorination *(like Piyush, Aquaguard)*	Others
Rainwater							
Other source							

2.17 What are the benefits of using rainwater harvesting to you?

- ☐ Time saving
- ☐ Easy access to water
- ☐ Better attendence of children in school
- ☐ Better hygiene
- ☐ Improved diet by kitchen gardening
- ☐ Income generation by livestock rearing, vegetable gardening, etc.
- ☐ Less accidents/ hazards while fectching water
- ☐ Less quarelling over scarce water source
- ☐ Others

3. Level of satisfaction with RWHS

3.1 Is your RWHS working well?

- ☐ Very well
- ☐ Somewhat well
- ☐ Neither well nor bad
- ☐ Somewhat bad
- ☐ Very bad
- ☐ No response

3.2 Are you satisfied with your rainwater harvesting system? Indicate level of satisfaction.

- ☐ Fully satisfied
- ☐ Somewhat satisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Somewhat dissatisfied
- ☐ Fully dissatisfied
- ☐ No response

3.3 What are the main inconveniences/constraints of the RWH system?

(Let respondent answer freely, and then tick answer)

- ☐ Irregular rainfall
- ☐ Insufficient water to cover the demand
- ☐ High cost of investment
- ☐ Insufficient capacity of the tank
- ☐ Breakdowns of the system
- ☐ Health risk
- ☐ Need of maintenance
- ☐ No response

Others _____

4. Perceived changes in the water availability

4.1. During the last 10 years, have you observed any changes in your environment which have not occurred before?

- ☐ Yes
- ☐ No

4.2. If yes then, what kind of events have you observed which had not occurred in your community before?

- ☐ Drought
- ☐ Flood
- ☐ Landslide
- ☐ Irregular rainfall
- ☐ Earthquake
- ☐ Fire
- ☐ Strong wind
- ☐ High/Low Temperature
- ☐ Human/Livestock disease

4.3. Overall, would you say that the precipitation patterns in your area/community have changed over the last 10 years?

- ☐ Yes
- ☐ No

4.4. If yes then, how has the precipitation patterns changed in your area/community over the last 10 years?

- ☐ Increased annual precipitation
- ☐ Decreased annual precipitation
- ☐ Increased monsoon precipitation
- ☐ Decreased monsoon precipitation
- ☐ Increased winter precipitation
- ☐ Decreased winter precipitation
- ☐ Advanced timing of precipitation
- ☐ Delayed timing of precipitation

Others _____

4.5. Do you think change in precipitation pattern will have impact in your community?

☐ Yes

☐ No

4.6. If yes then, what impacts will change in precipitation pattern have in your community?

☐ No water availability in the RWHS

☐ No water available in other water sources

☐ Danger of damage to the RWHS

Others _____

4.7. Are you aware of the concept of Climate Change?

☐ Yes

☐ No

4.8. If yes then, what impacts will Climate Change have on the water availability?

_____

5. Sustainability of RWHS

5.1 How often do you clean your RWH tank?

☐ Every two months ☐ Every six months ☐ Annually ☐ Never

5.2 Have you ever repaired or maintained your RWHS?

☐ Yes

☐ No

If yes then, when did you repair or maintain your RWHS? _____

From whom did you get it repaired or maintained? _____

5.3 In your opinion, what is the cost involved in repairing or maintaining your RWHS?

☐ Very low

☐ Somewhat low

☐ Neither low nor high

☐ Somewhat high

☐ Very high

☐ No response

5.4 For how many months do you use the rainwater from RWHS, after dry period starts?

- ☐ 1 month
- ☐ 2 months
- ☐ 3 months
- ☐ 4 months
- ☐ 5 months

5.5 Is the existing RWHS's capacity sufficient enough to meet the water demand/needs of your household during dry period?

- ☐ Yes
- ☐ No

5.6 During dry periods, how do you manage the use of rainwater from your RWHS?

- ☐ Use rainwater only for drinking purposes
- ☐ Using rainwater for drinking and cooking purposes
- ☐ Using water from other sources for other purposes
- ☐ Consume less water for cleanliness/hygiene
- ☐ Reuse water

Others _____

5.7 Do you think RWH is a useful adaptation method in the context of adverse impacts of Climate Change – water scarcity and drought?

- ☐ Yes
- ☐ No

If yes then, how will RWH be the useful adaptation method in case of water scarcity and drought?

_____

OBSERVATION			
a) Condition of tank:	☐ Good ☐ Fair ☐ Poor		
b) Type of tank:	☐ Ferrocement tank ☐ Stone masonry ☐ Plastic lined tank ☐ Other _____		
c) Type of catchment area:	☐ GI roofing sheet ☐ Slates ☐ Tiles ☐ Other _____		
d) Size of catchment area:	m^2		
e) Capacity of tank:	m^3		
f) Roof of tank sealed:	YES	NO	
g) First flush system:	YES	NO	
h) Tank inlet screened:	YES	NO	
i) Presence of overhanging branches:	YES	NO	
j) Proximity of tank to livestock:	☐ Less than 3m ☐ Between 3m and 10m ☐ More than 10m		
k) Presence of stagnating water (e.g. pools of water, open containers of water):	YES	NO	