Government of Nepal
Ministry of Water Supply & Sanitation
Department of Water Supply & Sewerage
Water supply & Sanitation Division Office, Arghakhanchi

Study of Potentiality of Rainwater Harvesting System as a Climate Change Adaptation Option in Arghamaidan, Arghakhanchi district

Final Report

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ACRONYMS AND ABBREVIATIONS

WHO	World Health Organization
DWSS	Department of Water Supply & Sewerage
WSSDO	water Supply & Sanitation Division Office
WMDC	Watershed Management & Development committee
VWASHCC	Village Level Water supply, Sanitation and Hygiene Coordination Committee
NAPA	National Adaptation Programme of Action
CDG	Community Development Group
WASH	Water, Sanitation and Hygiene
DDC	District Development Committee
O&M	Operation and Maintenance
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads
GESI	Gender Empowerment and Social Inclusion
GoN	Government of Nepal
GPS	Global Positioning System
IEE	Initial Environmental Examination
MIS	Management Information System
MOE	Ministry of Environment
MoF	Ministry of Finance
LAPA	Local Adaptation Programme of Action (in response to climate change)
RVT	Reservoir Tank
VDC	Village Development Committee
HHs	Households

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Division Chief

WSSDO,Arghakhanchi

EXECUTIVE SUMMARY

The proposed project will support communities to access and reliability to water resources. Existing water supply systems will be improved and rainwater will be harvested for domestic purposes. The project will construct some structures that will help to trap run-off on the ground and roof of Argha-temples and HHs from the settlements while at the same time developing them for ground water recharge. The project will construct rainwater collecting trench and recharge pit to recharge spring and stream sources. The project will help communities to manage and conserve catchments in an integrated and inclusive way.

Crucial proposed activities are:

1. Introductory meeting at each cluster of the wards.
2.Training and awareness programme on rain water harvesting, climate change adaptation and reverse sloped terracing of agro-fields.
3. Training to youths from all clusters in a inclusive way.
4.The existing drinking water and irrigation supply infrastructure that uses water sources will be improved and upgraded or further expanded.
5.Construction of rooftop rainwater collection system in Aghamandir, every households and school buildings.
6.Construction of rainwater collection RVT at least of 50 m3 capacity to 100m3 at suitable intervals.
7.Construction of check dams in rivulets and rainwater collecting trenches.
8.Construction of road catchments.
9. Construction of recharge ponds and pits for ground water recharge and irrigation.
10. Capacity building of Local users committee

In addition to these activities, it includes intensive vegetative restoration measures in the immediate surroundings or the water sources as well as targeted conservation measures in the other parts of the catchment management areas. Degraded forest/land rehabilitation will include vegetative and bio-engineering measures on degraded forest/shrub/grass covers and barren lands. These measures will include planting of trees, shrubs and grasses with necessary conservation measures; erosion control measures such as brush layering and other bio-engineering works, drainage diversion and regulating grazing and human biotic interference in these areas.

Arghamaidan is one of the tourist sports of the district having just seven kilometers of graveled road from district headquarter, SandhiKharka. It falls on the sub-tropical region of the district at a altitude of around 1650m. Due to local and global actions, climate change is mounting pressures on water resources and livelihoods in Arghamaidan of Argha VDC.It's mountainous and challenging topography and socio-economic conditions make it a highly vulnerable to climate change. The deterioration of the natural resources has contributed to constant rural poverty and migration to district headquarter and Tarai.

The project has no adverse effect on environment. Moreover, it will add value for tourism development of historical place. Project activities ensure participation and gender equality and social inclusion at all level. Direct benefits including increased yield of springs, enhanced greenery, changed microclimate, equality and easy access of water resource for all from the project will get by 303 HHs down to the Arghamaidan. The proposed activities are expected to complete within three consecutive fiscal years. The approximate cost estimate for all proposed is estimated is Rs 35696000.00.The per capita cost is calculated as Rs 27916.0.The project site looks very attractive site for rain water harvesting but it needs detail investigation like infiltration, evapotranspotation, need of bio-treatment , soil type, saturated hydraulic conditions, amount of storm water runoff volume, soil type, pollutants, geotechnical hazards,demad and supply, recycled water use conflicts, operational and treatment challenges, reliability of water quality, geotechnical and structural stability for précised design, estimate and utility of water resources.

1. GENERAL INFORMATION

1.1 Introduction

Safe drinking water supply and sanitation are the utmost needs of human being. Nepal has set a goal of reaching the universal basic water supply and sanitation coverage by 2017.However, the goal looks quite challenging as the WASH sectors are still finding difficulties in resolving the issues of unreached coverage of water supply of approximate 16%. Moreover, among the built projects more than 50% have the issues of functionality.

In the global context of climate change, its impact in Nepal and particularly in Water, Sanitation and Hygiene (WASH) sector has been becoming more significant day by day. This is due to increased frequency of extreme weather events such as floods, droughts and landslides. In some areas these changes have led to depletion of sources which resulted in severe scarcity of water in natural sources which is consequently affecting sustainability and operation and maintenance (O&M) of water supply, sanitary systems and hygiene facilities. Under various climate change scenarios for Nepal, mean annual temperature rise in Nepal is projected to be between 0.4 to 0.6 Celsius per decade. Annual precipitation reduction is projected to be in a range of 10 to 20 % across the country But if mitigation and adaptation steps are taken.
This will translate into decreased availability of drinking water availability and quality as well as for multiple uses, which can worsen impacts on human health, sanitation and hygiene services and practices. Livelihoods and food production will also be heavily impacted. The deterioration of the natural resources has contributed to constant rural poverty and migration to urban areas and even other countries.

Considering these potential impacts, Nepal has included climate change as part of commitments to the Millennium Development Goals and the Sustainable Development Goals. Nepal's policy framework and action plans related to climate change reflect its commitment to the international treaties. The Climate Change Policy, National Adaptation Programme of Action (NAPA) are some of the policy guides which were prepared in this line. WASH stakeholders and Joint Sector Review 2014 recommends that a comprehensive study on the impacts of climate change is very necessary and timely.

As other parts of country, Arghakhanchi district is also affected by climate change impacts although detail study does not exist. It had aggravated situation in some parts of the districts where water scarcity was already there. One of the areas is Arghamaidan, which is located in SandhiKharka Municipality, Ward No. 12 (Old Argha VDC 1, 2, 3).

Department of Water Supply and Sewerage (DWSS) as the designated lead agency in this sector have been implementing various programs to improve water and sanitation condition in the country. Among others, it has been conducting various studies to address water scarcity problems in order to implement projects thereafter to solve these problems.

This study aims to identify potentiality of rainwater harvesting and integrated watershed management with interventions in upland areas to increase surface water storage and groundwater recharge to access to more reliable water resources for communities living in the watersheds of SandhiKharka municipality-12, Arghamaidan, which are significantly vulnerable to climate change. Access and reliability to water resources will be improved and rainwater will be harvested for domestic purposes.

1.2 Project Background

Communities down to the Arghamaidan are facing huge water scarcity in dry season because of depletion of traditional spring sources and uneven distribution of rainfall pattern, resulting less reliability of water resources for domestic purposes. Acute need of water has created new development of conflict that is claiming of spring source. The hard time to manage drinking water supply is during dry period from Magh (Jan/Mar) until Jestha (May/Jun). Very little or no water through pipe supply system. In such case, the average time to fetch one trip of water range from 1 to 1.5 hours. The situation is even bad at present due to defunct system or damaged water supply system.

The preliminary observation shows that there is a need of strategic program to address water scarcity problem in the area which may require building climate resilience watershed through an integrated watershed management with introduction of rainwater harvesting system.

The Project was selected in DDC council meeting of fiscal year 2072/073 in Arghakhanchi district. This will include integrated watershed management & conservation, rainwater harvesting, traditional water source protection measures, ground water recharge as a part of climate change adaptation to improve water sources for drinking water, domestic purposes and irrigation.
As a front liner implementing agency of DWSS, Water Supply and Sanitation Division office Arghakhanchi, took initiatives with concept of harvesting rainwater beyond traditional Box.
Study of Potentiality of Rainwater Harvesting System as a Climate Change Adaptation Option in Arghamaidan, has thus been developed to initiate this process. WSSDO, Arghakhanchi will conduct this study in support from the World Health Center (WHO) and the Department of Water Supply & Sewerage.

2. METHODOLOGY

2.1 Literature Review

A scan of secondary sources of information regarding various data like rainfall pattern in last twenty year, temperature rise in Nepal, crop pattern, distribution of slope, elevation zone, geology, distribution of soil type, land use/cover, migration rate, vulnerability from natural factors.

2.2Reconnaissance visit & Stakeholder Consultations

Preliminary reconnaissance visit to the potential area was undertaken Jestha 2073 in Arghamaidan catchments and existing water supply and irrigation facilities. A track record of the path followed during visit was shown in figure 1. The team of experts collected

Figure 1: Reconnaissance at Arghamaidan

information about bio-physical conditions, traditional water sources, watershed,resource,useand management as well as socio-economic conditions. The community consultations carried out through consultation meeting and discussion with local water users' committees of Argha VDC.

2.2 Data Collection& Processing

The required monthly and annual climatological data such as mean annual precipitation mean annual temperature, population density, land use/land cover, geology, distribution of soil types were collected from Department of Mine and Geology and Department of Hydrology and Meteorology and Soil Sottetr Database, FAO 1979. The obtained data were processed to produce necessary output.

2.3 Site Verification from district level

The proposed site was verified by the district team with representatives from DDC, district irrigation office, district soil conservation office including water supply and sanitation division office. The team discussed with local water supply users' and irrigation users' committee and visited all the sources, inspected the existing water supply and irrigation infrastructure, measured the yield of the water sources and confirmed the number of users. Dhobata (0.41lit/se,May,2016) in and Dharapani source(0.04lit/sec,May,2016) are key spring sources in which most of the population of the proposed area depend for drinking water and irrigation which is shown in fig 2. A rapid assessment was carried out of the condition of the catchment area of the water sources, the yield of the source, the condition of the existing intake, storage ,transmission and distribution lines and the absence of alternative water supply sources.

Fig. 2: Dharam Panimul

Present use of the water source - drinking water, irrigation or both - was discussed with users. Particular attention was given to any existing conflicts with regard to the use of water from the existing water sources and the potential conflict that could arise from further development of the water source including multiple use water for irrigation and drinking purposes between users.

Figure 3: Dhobata Muhan

Access to water sources by disadvantaged groups, in particular members of Dalit (Gandharbha community) household was reviewed. The communities were informed that equal access with no discrimination to the water sources for all beneficiary households was a pre-condition for assistance.

Fig 4: Catchment for Dhobata Source

2.4 Site Investigations

For the preparation of the proposed site, a study team comprising Team leader, biologist, sociologist, civil engineer, hydrologist and water supply technician and community representatives - was carried out of proposed project site and existing water sources and drinking water supply and/or irrigation infrastructure.This study team together visited the selected site and discussed the potentiality of Rainwater Harvesting System as a Climate Change Adaptation Option in Arghamaidan, Arghakhanchi district. The team discussed the need of infrastructures for collecting and channeling rainwater for domestic and irrigation purposes.

Fig6: Catchment for Ranidaha

Fig 5: Rani Daha (800m3)

Fig. 5 is a traditional pond, Namely, Rani Daha which is fed by storm runoff from the catchment shown in fig. 6.The selected watershed areas have been geo-referenced with

GPS equipment.The condition of the forest and vegetation land cover in the watershed management areas was evaluated. All erosion and slope stability problems were geo-referenced as well as the location of degraded land and forest/vegetation cover.

2.5 Mapping

After the site investigation, watersheds and catchments were mapped in GIS and

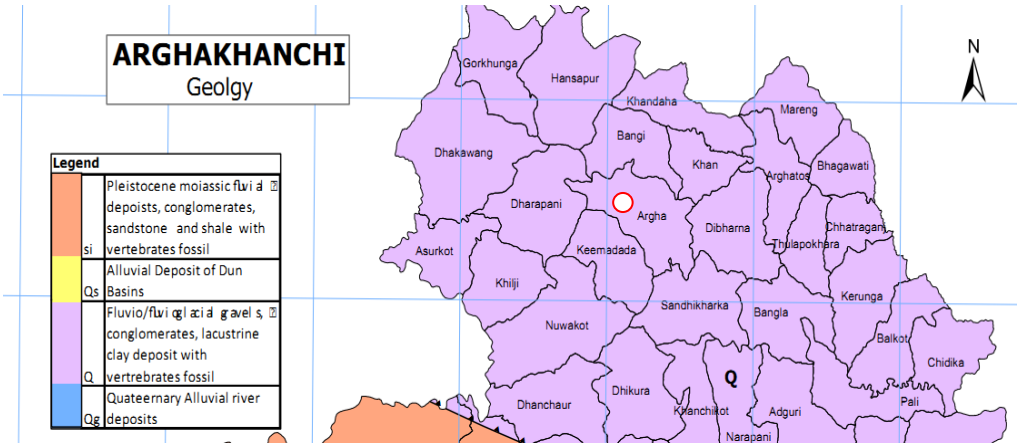

Fig: 7Geology Source: Department of Mine &Geology

Google Earth and with the use of the topographical land use maps, hydrological boundaries were identified .Using the high resolution imagery available in Google Earth, a preliminary assessment was made of the condition of the identified watersheds. Special attention was given to the identification of slope stability and erosion problems in the management areas or near the settlements or agriculture land of the water users.

Figure 8: Study Area

2.6 Water Resources

Spring sources are the main source of water for drinking water, sanitation and irrigation purposes in Argha maidan.Most of the population in Arghamaidan reside in ridge area of the hill. According to local people, the all sources are depleting day by day. There are two solar pumping and electrical pumping (Defunct now) water supply systems are in existence. Total number of spring sources and their discharge are given in table below:

Table1.Spring sources in Project area

S.N	Name of Sources	Discharge(lit/sec)	Remarks
1.	Dharapani	0.04	May 2016
2.	Gollaune(hile)	0.03	May 2016
3.	Dhobata	0.41	May 2016
4.	Odarpani	0.03	May 2016

3. PROJECT AREA

3.1 Project Location

Arghakhanchi district extends between 27'45"N and 28'6"N latitude, and 80'45"E to 83'23"E longitude. It covers 1,193 km². Argha VDC covers 19.29 sq. km area. The Top of the project, Aghamandir lies at an altitude of 1698m from mean sea level. But the project area's elevation varies from 1432 to 1698 meter above the sea level. The Project site is located in Argha VDC (Sa.Na.Pa-12) of Arghakhanchi District. It lies on sub-tropical climate region of the district.

3.2 Households and population

According to the national census 2068, the total population of the Argha VDC is 5331.But within the potential area for study is 1629. The population growth rate is-1.28.The sex ratio, number male per 100 female is 74.61.

3.3 Migration

Migration pattern includes the in and out migration from village. The proposed study area has the higher out going migration (approx. 84%) than in migration (16%). Basically the family from which a man has gone in foreign employment, they have been shifted for the purposes of study of their kids to the district headquarter. Some of the families are shifted to Tarai regions, few of them to Kathmandu.

3.4 Land Use/Land Cover

Almost all the families have land ownership. We can see abandoned homes too .Gandharbha community has a compacted settlement. Most of the lands have been used by other than owners. General land use and land cover of the potential area is shown in fig 9 below.

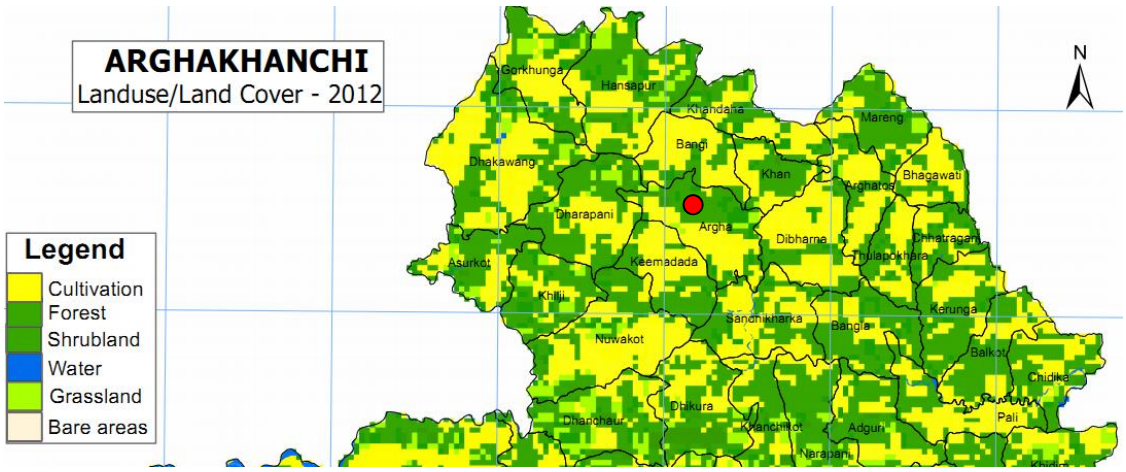

Fig. 9: Land use/Land cover of project area

Data Source: Landset Thematic Mapper, 2010

3.5 Rain fall& Temperature

For accurate design, estimate and utility of rainwater harvesting in a broader sense needs to have knowledge of pattern of rain fall and temperature around the proposed project area. The complex topography plays a major influence in temperature and rainfall in Nepal. Monsoon normally starts from the second week of June (10 June) and retreats in the fourth week of September (23 September).. The effect of monsoon is more in the eastern half of the country where as western half especially the northern parts of mid-western development region are generally drier compared to the eastern half. The high precipitation Monsoon normally starts from the second week of June (10 June) and retreats in the fourth week of September (23 September. For the analysis of temperature and rainfall in proposed project area, there is one meteorological station at Khanchikot of Arghakhanchi distrct.For rainwater harvesting we should have knowledge of precipitation contribution .Fig. 10 shows the seasonal contribution of precipitation, Monsoon season contributes about 80.5 percent of the total annual precipitation of the country and is the main source of precipitation in Nepal. The winter season (Dec-Feb), Pre monsoon (March-May), Monsoon (July-Sept),Post Monsoon (Oct-Nov) has different contribution of percentage of annual precipitation. Similarly, the mean precipitation variation of Nepal shown in fig. 11.It shows our potential area has the mean precipitation of 1600-2000milimeters during monsoon.

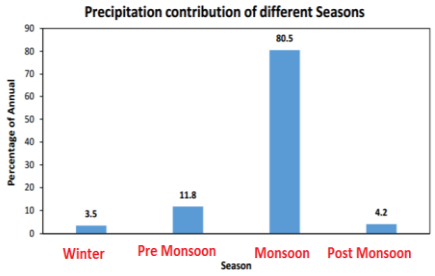

Figure 10: Seasonal contribution of Precipitation

Source: DHM, 2015

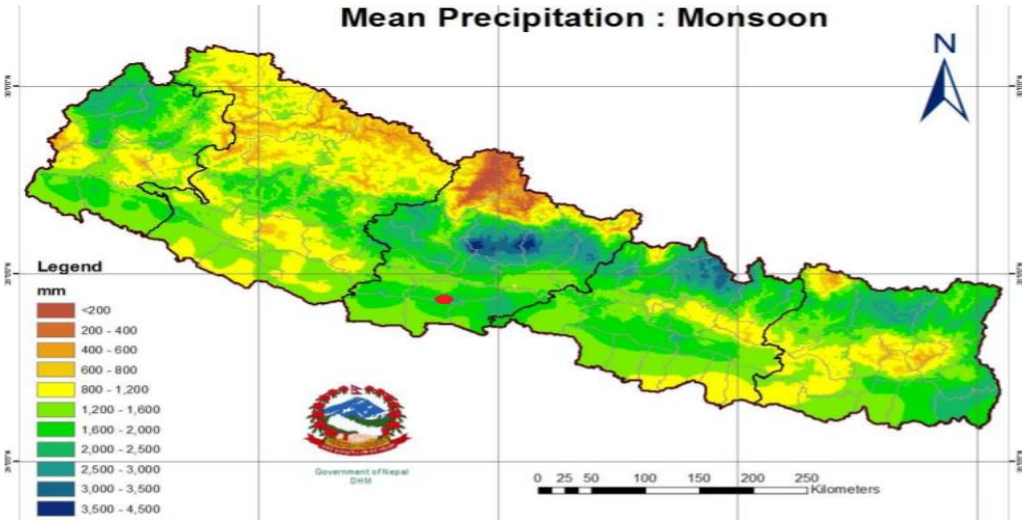

Figure 11: Mean Monsoon precipitation variation over Nepal

Source: DHM, 2015

For précised calculation of evapotranspotation from the ground or surface or ponds, the mean air temperature during monsoon season is shown in figure 12.The mean maximum temperature in potential area varies from 22-26 degree centigrade. than in minimum temperature. for trend analysis

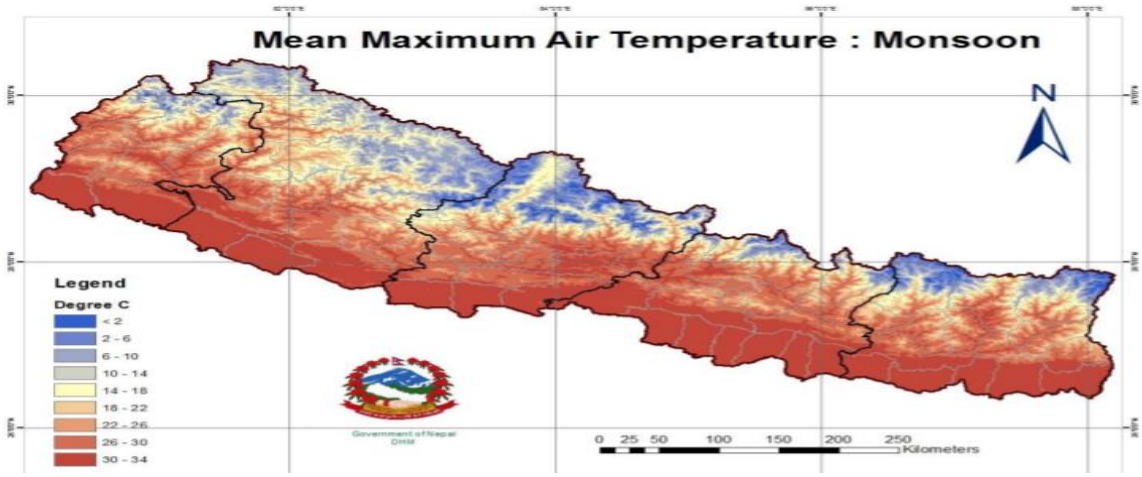

Figure 12: Mean Monsoon Maximum air temperature variation over Nepal

Source: DHM, 2015

3.6 Access to markets

Access of district headquarter, SandhiKharka, from the settlements of the proposed site is seven kilometers. The access road is all weather graveled road.

3.7 Gender and Social Inclusion

Women and children are hard hit s they are responsible for household water management. Acute need of water has created new development of conflict that is claiming of spring source. The potential area In comparison to other rural parts of the district, there is lesser degree of gender disparity between women and men and between different social groups. This project site is one of the educated VDC of the Arghakhanchi district .So, It needs less efforts to re-balance these power relations and equal rights, opportunities and respect for all individuals regardless of their social identity. Particularly, we need some process by which Gandharbha community (Dalit) should be mainstreamed in every steps of project.

3.8 Irrigation Facilities

Rain fed agricultural system is dominant practice in the proposed area with no access of earthen types of irrigation canals from the local streams. They use excess water from natural spring in rainy season via HDPE pipe or small temporary tyoe earthen canal for irrigation. They don't have rivers and streams for irrigation. There are existing irrigation ponds in project area. Capacity of one pond (Ranidaha) is 800m3.Those ponds are being used in vegetable farming particularly in the dry season.

3.9 Water supply for Domestic use and Livestock

3.9.1 Access to Water:

The main source of drinking and domestic water supply in Arghamaidan is spring sources. Clusters from the potential area namely, Maidan, Pathawang, Rajupani, Itparne, Masinedanda, Ranigaira, Odarpani, Kudapani, Khada and Rasichaur (old Argha-1,2,3) are being supplied/distributed through pipe system. Water sources can be divided in the traditional sprouts temporary structures for water collection and formal water supply systems with water collection/intake structures, storage facilities and piped distribution system with tap stands. Most of the formal water supply systems are fully or partially defunct due to lack of proper operation and maintenance fund, maintenance worker and tariff system. Normally, the system serves basic demand water for four months (Jul to Nov) in a year. Spring yields are slightly high during monsoon season (June-September). With yield reduces people have to depend or search for other sources (springs). Normally it starts from December ahead. The hard time to manage drinking water supply is during dry period from Falgun (Feb/Mar) until Jestha (May/Jun). Very little or no water through pipe supply system. In such case, the average time to fetch one trip of water range from 1 to 1.5 hours.

3.9.2 Technical and Financial Support for drinking water infrastructure and irrigation

WDDSO/DDC/VDC funds have been used for technical and financial supports for constructing the water supply schemes. Local water sources have been improved by The communities, themselves managed funds for construction the water sources particularly the traditional source like local wells and spring taps).Water Supply and Sanitation Division Office (WSSDO), have been providing support for water supply. Irrigation ponds fed by storm water are being constructed.

3.9.3 Demand and Supply

The standard design in rural water supply project is 45 lpcd. According to local water users, they spent 1-1.5Hr per trip (15-20 lit) in dry season. Most of women and school children are being used for water fetching from traditional spring sources. The proposed project area is already declared open defecation free area. But due to lack of minimum water supply to consumers, it has been suffering for basic hygiene and cooking needs. The consumption depends on the climatic conditions and social/cultural norms in the Project area, the basic survival needs will be closer to 15 l/c/d. In addition the water requirements for livestock are other challenges.

4. PROPOSED PROJECT

4.1 Project Objectives

This potential site needs to develop to have access to more reliable water resources for communities living in the watersheds of SandhiKharka municipality-12, Arghamaidan,(old Arghamaidan-1,2,3, Approximately 303 HHs) which are significantly vulnerable to climate change. Access and reliability to water resources will be improved and rainwater will be harvested for domestic & irrigation purposes. It needs construction of large scale rainwater tanks, and ponds to trap run-off on the ground and roof of Argha- temples and HHs from the settlements while at the same time developing them for ground

Fig 13: Recharge ponds & pits

Photo: WSSDO, Arghakhanchi

water recharge. Construction of rainwater collecting trench and recharge pits to recharge spring and stream sources and ponds. The project will help communities to manage and conserve catchments in an integrated and inclusive way. Fig.13 shows some recharge ponds and pits for ground water recharge to support existing spring source.

Fig. 14: Filled recharge ponds and pits from storm run off

Photo Credit: WSSDO, Arghakhanchi

The expected impact will be that climate resilience in the Project communities is improved. The Project's outcome will be that selected communities significantly vulnerable to climate change have access to more reliable water resources. Approximately 303 households are expected to benefit from improved water availability during the dry season to support domestic and

Fig. 15: Traditional Spring Source

Photo: WSSDO, Arghakhanchi

Fig. 16: Improved Water Availability

Photo: WSSDO, Arghakhanchi

Agricultural use.Spring water sources are expected to become more reliable; the dry season water yield will either remain the same or increase. As shown in figure 14 and 15, how we can develop and protect unsafe and unreliable traditional water sources into more reliable and safe water source.

4.2 Proposed Major activities

The intended programme for proposed project for restoration and conservation of selected catchment area will include the following activities:

1. Introductory meeting at each cluster of the wards.
2. Training and awareness programme on rain water harvesting, climate change adaptation and reverse sloped terracing of agro-fields.
3. Training to youths from all clusters in inclusive way.
4. The existing drinking water and irrigation supply infrastructure that uses water sources will be improved and upgraded or further expanded.
5. Construction of rooftop rainwater collection system in Aghamandir, every households and school buildings.
6. Construction of rainwater collection RVT at least of 50 m3 capacity to 400m3 at suitable intervals.
7. Construction of check dams in rivulets and rainwater collecting trenches.
8. Construction of road catchments.
9. Construction of recharge ponds and pits for ground water recharge and irrigation.
10. Capacity building of Local users committee.

4.3 Protection of the area surrounding the water source

The protection of the area surrounding the water sources will involve both intensive vegetative restoration measures in the immediate surroundings or the water sources as well as targeted conservation measures in the other parts of the catchment management areas.

Fig. 17: Catchment Protection

Photo: WSSDO, Arghakhanchi

The following measures are included degraded forest/land rehabilitation will include vegetative and bio-engineering measures on degraded forest/shrub/grass covers and barren lands. The measures will include planting of trees, shrubs and grasses with necessary conservation measures; erosion control measures such as brush layering and other bio-engineering works, drainage diversion and regulating grazing and human biotic interference in these areas.

4.4 Treatment of Catchment Land

Gully erosion and slope/landslide stabilization that threatens the water sources, special attention will be given to control the mass wasting processes in the catchment management areas which includes the following:

a) Gully treatment. A gully is an erosion channel cut by concentrated run off that usually only flows during and immediately after heavy rainfall. The treatment involves land use improvement around and above the gully; vegetative control measures.

Fig. 18: Gully Treatment

Photo: WSSDO, Arghakhanchi

B.Reinforce the loose soil surface around and above the gully; structural techniques such as dry stone and gabion check dams in deep and wide gullies and retaining walls, and drainage management to prevent runoff entering in the gully and draining excess water from the gully C.Construction of diversion channels and earthen ponds to store runoff.

D.Slope correction with gabion or dry stone retaining walls cum check dams will be done.

4.5 Community participation

4.5.1 Watershed Management & Development Committee

For each of the selected catchment, there will be a catchment development committee for the facilitation and implementation of proposed activities and agreed contribution.WMDC will be responsible for the initial care of recently planted areas and for the management of the catchment areas and the O & M of the created drinking water supply and irrigation infrastructure. An important role of the WMDC is the implementation of social fencing of the catchment management areas and the regulation of grazing and other human biotic activities in these areas.

4.5.2 V-WASH-CC

At VDC level, existing V-WASH-CC will take major decision and other initiatives regarding this project. The V-WASH-CC will monitor proposed activities in project area, in particular support and supervise the regulatory function of the WMDC in connection with the establishment and maintaining the social fencing of catchment management areas and the regulation of the grazing and other human biotic activities in these areas.

4.6 Gender Inclusion

WMDC Committees for catchment management areas have at least 33% female and proportional representation of dalits and at least one leadership position (chairperson, secretary , or treasurer) will be female. Training programs will be targeted to women, Dalit, women, poor and excluded will be given preference in Project training activities and the productive land conservation measures.

4.7 Institutional Support

The institutional development support for the proposed activities will be under water supply and sanitation division office for the entire duration.

4.8 Environmental Assessment

Proposed activities involves upstream catchment management; re-vegetation/ tree and shrub planting, fencing and access control, landslide control; sheet/rill/ gully erosion control; drainage management; rehabilitation and improvement of spring intake structures for drinking water and recharge ponds both for recharge and for irrigation.; drinking water storage tanks with water taps at the source sites; reinforced concrete RVTs for water storage. The Project is in compliance with the following environmental criteria for project selection.

- No Project infrastructure will be constructed in Government forest land which require cutting of many trees. However, if cutting of trees can be avoided or only a few small trees need to be removed, Project infrastructure can be constructed in Government forest land by seeking concerned District Forest Office's permission.
- Land needed for recharge ponds and pits or RVTs will be provided from villagers.
- Proposed activities have no negative impact on downstream or other water users, but the Project interventions are expected to improve water availability for downstream users;
- Proposed activities are not located in, or will not cause any direct or indirect threat to, ecologically sensitive areas such as national parks, wildlife sanctuaries, forest areas, or wetlands, conservation areas of international significance, or areas of high historical, archeological, cultural or aesthetic value; but it will value for tourism development famous tourism Arghamaidan area.
- Proposed activities will not disrupt the life and property of indigenous communities, or tribal groups, but availability and access of water resource will add upgrade the quality of life like Gandharbha society.
- Proposed activities will not encroach on cultural features like places of worship, graves, cemeteries and historical monuments.

As per the proposed activities characteristics and the compliance with the environmental selection criteria, the proposed project falls as per the Environmental Act 2053 and Regulation 2054 as insignificant impact.

4.9 Implementation Schedule

It will be a three year program and shall be launched in 3 fiscal year.The first phase will include works as many as preparatory works need to be done. The second and third year will include other major construction activities. Activities will be carried out within three-year fiscal year. Detail project report (DPR) will be prepared within 6 months and detailed design of the proposed civil works

together with the determination of specific locations and details of the vegetative control measures will be under taken before the start of construction works.
Civil works and bio engineering works directly related to the protection of water sources and rainwater collection system will be executed during the first fiscal year. Vegetative conservation measures will be carried out under community contracts and community contribution arrangements.

Before the start of the 2017 monsoon season the nursery for the production of planting materials will be set up in the VDC. Planting of trees, scrubs and grasses will be started at the beginning of the 2017 monsoon season.

During the second work season problems or damages in the completed structures will be rectified and if necessary minor additional works will be undertaken. A the start of the 2018 monsoon season gaps in the recently planted areas will be filled and complementary vegetative works to the completed civil works will carried out. This is especially with regard to plantation in unstable areas that have been stabilized by construction of retaining walls and check dams. Tentative schedule of the project will be as follows.

Table 2: Schedule

				12 Quatersof 3 fisal years								
				1	2	3	4	5	6	7	8	9
S.N	**Activities**	**Units**	**Quantity**									
1	Intruductoy meeting	no	12									
2	Training and awareness programme	no	12									
3	Training to youths	no	4									
4	Upgrading existing Water supply systems and ponds	no	5									
5	Establishment of rooftop rainwater collection system	no	250									
6	Construction of rainwater collection RVTs	no	7									
7	Construction of rainwatercollecting trnches and check dams	km	2									
8	Construction of road catchments	km	2									
9	Construction of recharge ponds and pits	no	4									
10	Capacity development ofLocal users' community	no	12									
11	Evidience recordings	no	36									

5. ESTIMATED BENEFITS

The catchment restoration measures together with the development of the selected water sources by improving or reconstructing the different structures, benefits of the proposed project can be summed up as follows.

1. Revived or increase yield of traditional spring sources.

2. Enhanced greenery with better watersheds.

3. Changed micro-climate with more water availability.

4. People will feel more comfort regarding basic water supply and irrigation demand for small level of irrigation.

5. Equality and access of water resources for all.

6. COST ESTIMATE

A summary of project costs is given in Table below. Economic costs have been estimated by approximate thumb rule as per district rate analysis of Arghakhanchi district. The tentative cost estimate for the proposed activities is as below:

Table 3: Cost Estimate

S.N	Activities	Units	Quantity	Rate(NPR)	Amount(NPR)	Remarks
1	Intruductoy meeting	no	12	7000	84000	
2	Training and awareness programme	no	12	15000	180000	
3	Training to youths	no	4	15000	60000	
4	Upgrading existing Water supply systems and ponds	no	5	500000	2500000	
5	Establishment of rooftop rainwater collection system	no	250	50000	12500000	
6	Construction of rainwater collection RVTs	no	7	25000	10000000	400m3
7	Construction of rainwatercollecting trnches and check dams	km	2	1500000	3000000	
8	Construction of road catchments	km	2	1500000	3000000	
9	Construction of recharge ponds and pits	no	4	1000000	4000000	
10	Capacity development ofLocal users' community	no	12	25000	300000	
11	Evidience recordings	no	36	2000	72000	
				Grand Total(NPR)	35696000	

7. RISKS

There are some risks like participation and ownership of the project because it is completely beyond the traditional way of harvesting of rainwater. If users do not educate the possible threats of water scarcity in future, they might not be agreed to collect rain water in a huge . However, it is mostly likely that households with access to improved water supplies will adapt their practices to take advantage of the new situation. The greatest risk to the Project would be if land and water source protection measures are not well maintained after implementation and that they do not have the expected long term benefits for water availability in the project area. This would be likely to adversely affect all the expected benefits.

There is a risk that could arise due to lack of labor in some households. According to the 2011 census data, 20.68% of the population in the Argha VDC is working abroad. Most of these migrant workers are

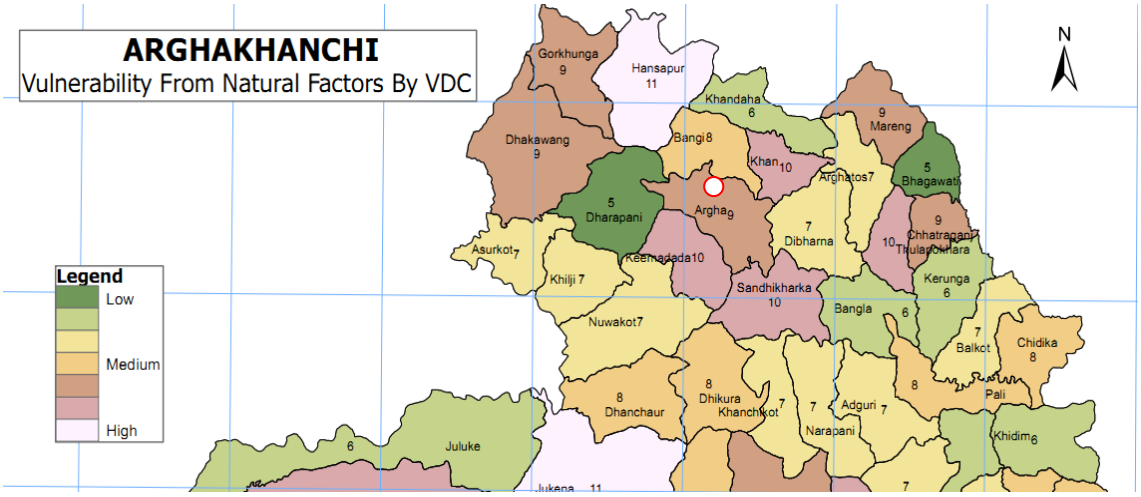

Fig. 19: Vulnerability from natural factors

Data Source: DDRMP Arghakhanchi 2011

men, with the result that women are disproportionately represented in the work force at home. While there are considerable variations in the number of absent family members in different locations, labor migration may reduce the interest or ability of some households in undertaking more labor intensive cultivation on their land. Lack of labor might also affect the ability of some households to participate in Project activities that require beneficiary participation. From above figure 13, the potential area has only medium kind of vulnerability from natural factors.

8. FINDINGS and CONCLUSION

At present, there are five water supply and sanitation users' committees in proposed vicinity. Water is a major problem in dry season especially from April to May. During that period women and children spent more than one and half hour to collect one gallon of water. Women and children are being used to collect the water. Data and experience shows that water sources are depleting day by day. There are more than ten small water supply existing systems. Out of them two schemes are fully defunct and other partially defunct. These scheme are using sources namely Dharapani, Odarpani, Gollaune, Dhobata. Yielding of these sources varies from 0.03t0 0.041l/sec.

The observation shows that there is a lot water scarcity of water in Arghamaidan area. The upper catchment has the barren with no vegetation. The storm water runs off quickly into the gullies. By climatological data, during March to May there is acute shortage of water when the demand of water is very high for domestic use, sanitation and hygiene but very little precipitation in the catchment. Further intervention like construction of roads is mounting pressure as it causes the very turbid and disturbance in catchment. We can't change the climatological input but we can develop our catchment to increase the yield of water sources.

So, to lessen the threats from the climate change we should shift to harvesting water sources beyond traditional box. We should develop the rain water harvesting technology in such a way that maximum amount of storm runoff can be trapped and collect so that it can be used in immediate need for domestic use and irrigation and to recharge ground water and contribution to springs.

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