Watershed Management Plan
of
Chhange Khola Micro-Watershed Management Plan
Khotang

Government of Nepal
Ministry of Forests and Environment
Department of Forests and Soil Conservation

Basin Management Centre, Koshi
Udayapur, Gaighat

Asadh, 2076

July, 2019

Acknowledgement

Watersheds are fundamental units of the management of land and water, identified as planning units for administrative purposes to conserve natural resources. While considering watershed conservation work, it is not feasible to take the whole area at once. Immense demand of the local communities, limited resources compel to prioritize and plan for rational implementation of the soil conservation and watershed management (SCWM) programs to ensure effective implementation and good governance. Taking this into consideration, the Basing Management Centre, Koshi has implemented drought management programme in Khotang district. In this context, micro-watershed management plan is needed to implement SCWM activities in effective and efficient manner.

This Chhange Khola micro-watershed management plan was prepared through participatory approach, intensive consultation and meeting with local communities and stakeholders from the watershed area. This plan is to guide the SCWM activities implementation effectively in aforementioned micro-watershed area. This plan would be useful to professionals, technicians and local stakeholders who are directly and indirectly involved in SCWM related activities implementation at the field level.

Successful completion of preparing the plan was possible with support and cooperation of various stakeholders, officials, and local communities, who were directly and indirectly involved in this rigorous process. I would like to express my sincere appreciation to all of them. I would like to thank Mr. Diwakar Bhattarai, GIS expert department of forests and soil conservation (DFSC) for providing his valuable experise in preparing the plan. My especial thanks also go to Mr. Rajdhan Rai (Soil Conservation Assistant), Basin Management Centre (BMC), Koshi Udayapur for coordinating and facilitating the overall works. I am also thankful to the officials from the DSCWM for their invaluable suggestions and generous supports in many ways. I hope the document will be useful for achieving the intended goal of BMC, Koshi Udayapur.

Uddhaw Bahadur Ghimire

Senior Watershed Management Officer
Basin Management Centre, Koshi, Udayapur

Asadh, 2076
July, 2019

Summary

Forest, agriculture and livestock play major roles in sustaining the livelihood of the rural population of Nepal. Land and water are two major resources to maintain the agriculture and livestock economy in the country. Chhange Khola micro-watershed is of no exception from the effect of soil erosion and land degradation affecting the production system of the land and water therefore livelihood of the local population. Forest degradation and agriculture interventions are posing great threats to the environment in these areas. Due to soil erosion and in the lack of proper management of soil and water resources watershed degradation has been continuing. Watershed degradation accelerates ecological degeneration, decrease land productivity and water scarcity. As a consequence, severe flooding and drought have been a common phenomenon. This leads to reduced economic opportunities from land and water use, increase poverty thus social problems. This is more so for the poor and marginalized population due to their heavy dependency on natural resources and limited capacity to cope with the situation for their livelihood.

Watershed management plan of Chhange Khola micro-watershed of Halesi Tuwachung municipality, Khotang is prepared based on the assessment of the land degradation status of the watershed and status of the land use in fulfilling the basic needs such as food, fodder, fuel wood and water.

Main objectives of the watershed management plan are to manage and improve the production base resources mainly land, water and vegetation in fulfilling the basic needs on sustained basis without degradation of resource base and reduce the impact of water induced disasters such as landslides and flood; and carry out the mitigation and adaptation measures for specific location to reduce the land degradation and to improve the greenery for sustained livelihood improvement. Furthermore, it will help in study and research on drought management. Such plan will prioritize the community needs and identifies the conservation activities of immediate needs. Such activities will be the basis for the implementation.

Major activities identified are related with sustainable land management, disaster risk reduction and natural hazard management, water and sediment management, development infrastructure protection, climate change adaptation and resilience development, awareness, and extension and demonstration.

Participatory implementation approach will be adopted to materialize the planned activities. Participation of the community group formed on the community basis will be integral part of the detail planning, implementation and management of the proposed activities. Cost of the planned activities to be implemented is estimated to be about 32 million rupees.

Table of Contents

List of Figures

List of Tables

1. Background

Nepal is a landlocked Himalayan country with an area of 147181 Km^2. The mean width is about 193 Km. In such short stretch the altitude of place varies from 59 m (Kechanakalan of Jhapa District) to 8848 m (Mt. Everest) MSL, south to north in different geological and geographical features. The total population of Nepal is 2,64,94,504 including male 1,29,27,431 and female population is 1,36,93,378 (Census 2011). Nepal is characterized by sources of many small to large size rivers, which flow from north to south. Koshi, Gandaki and Karnali are major River systems of the country. Nepal receives yearly average precipitation of more than 1200 mm. About 80% of the total precipitation occurs during June to September and Nepal faces "too much water" and "too little water" problems. It is a known fact that with the absence of storage reservoir (or flood control reservoirs), river regulation and proper watershed management practices in the mountains and hills of Nepal, much of the rainfall which occurs during the monsoon from June to September for a duration of four months is converted to runoff and drained by channels, rivulets and rivers that create flash floods and inundation on flatter topography, especially in Terai, causing loss to lives and damage to infrastructures every year.

Forest, agriculture and livestock play major roles in sustaining the livelihood of the rural population of Nepal. Land and water are two major resources to maintain the agriculture and livestock economy in the country. Forest degradation and agriculture interventions are posing great threats to the environment in these areas. Due to soil erosion and in the lack of proper management of soil and water resources watershed degradation has been continuing. Watershed degradation accelerates ecological degeneration, decrease land productivity and water scarcity. As a consequence, severe flooding and drought have been a common phenomenon. This leads to reduced economic opportunities from land and water use, increase poverty thus social problems. This is more so for the poor and marginalized population due to their heavy dependency on natural resources and limited capacity to cope with the situation for their livelihood.

The erosion hazards are particularly very high in the Middle Mountain, High Mountain, as well as Chure hills physiographic region and flooding at the flat area of Chure and Tarai region. The forest degradation and deforestation due to encroachment, illegal logging and over grazing in-sync with heavy downpours are the major causes for increase the risk of slope failures, mass movements, landslides and flash floods. Also, due to harsh topography and inaccessibility, degradation is unabated in many areas of is considered one of the most degradable regions in Nepal having significant impact on environment, economy and livelihoods of people living. Land degradation in the form of soil erosion, landslides and riverbank cutting is also one of the major environmental problems and almost all types of land degradation that exist in Nepal. The main processes that lead to the degradation of watersheds are landslides, Soil erosion, floods, biodiversity loss, and unsustainable water extraction and farming practices. Steep topography, weak geology and intense monsoon rainfall further exacerbate the degradation process. Deforestation, overgrazing, and poorly managed degraded marginal lands further contribute to the degradation of watersheds of Nepal.

Integrated watershed management has become essential to reduce accelerated landslides and soil erosion in upstream areas; minimize negative impact of flash floods and sedimentation in downstream areas; reduce adverse impact on the people's livelihood, agriculture and water resources; promoting proper conservation and utilization of land, water and vegetation resources and improving productivity of the land to meet people's daily basic needs mainly food, fodder, fuel wood, timber and water for sustained livelihood, for environmental protection and conservation of watersheds and micro-watershed in general. This plan is prepared to identify and address issues related to Chhange Khola micro-watershed

resources degradation particularly land, water and forests; climate change, disaster risk reduction and livelihood of the local people.

Therefore, watershed management became essential to reduce the adverse impact on the agriculture and water resources guarding proper conservation an utilization of land, water and vegetation resources and improving productivity of the agriculture land to meet people's daily basic needs mainly food, fodder, fuel wood, timber and water for the sustained livelihood, for environmental protection and to reduce degradation of fragile watersheds in the district. Flash floods in downstream originate from unmanaged degraded watersheds cause severe damage to the livelihood assets of communities. Beside flash flood, runoff from unmanaged watershed causes water induced hazards such as surface erosion, gullies and landslide disrupting the people's livelihood by reducing the land productivity and causing the damage to the land, infrastructures and lives.

In federal system, the Government of Nepal has continued extension of technical services of soil conservation and watershed management through establishment of four basin management centres (Koshi, Gandaki, Karnali, Mahakali) keeping river basin management work on high priority. Accordingly, the Basin Management Centre (BMC), Koshi, Udayapur with 24 districts (14 of province, one, 5 of province, 2, and 5 of province three) as its working area of 42090.90 square kilometres, was established on 26th of 2075 B.S under the ministry of forests and environment (MoFE), department of forests and soil conservation (DFSC). In course of programme execution, i.e. drought area management for water resource management and utilization, the Chhange Khola micro-watershed area was seen to be appropriate to work and establish a demo site for study and research purpose to develop drought management technologies to be replicated.

2. Selection of micro-watershed/ Project Area

The micro-watershed is characterized by steep slopes and numerous formation of erosion along the ridges and streams. The risk of flash flood at the lower part of the micro-watershed from the Sapsukhola, tributary of Koshi river, during the monsoon as well as river/stream bank cutting problem threating many settlements and agriculture land and very drought area having water stress. This situation is bringing socio-economic hardness as well as environmental challenges. Further, forest encroachment, deforestation, and over grazing are exerting more pressure on forests, land and water resources causing threat to ecosystem and society. Hence demands immediate integrated watershed management planning and its implementation for sustainable management of natural resources and benefit sharing mechanism between upstream and downstream communities. The Chhange Khola micro-watershed is selected for formulation and implementation of integrated watershed management plan because of its water stress, high vulnerability to incidences of floods and landslides, and to improve the livelihood of the community and balance the ecosystem and biodiversity establishing drought management site.

3. Objectives

The main purpose of formulation and implementation of micro-watershed management plan of Chhange Khola micro-watershed, Khotang, is to increase the productivity and utility of land and water and to prolong the services of development infrastructures leading towards livelihood improvement on an equitable and sustainable basis through integrated soil conservation and watershed management.

Specific objectivity:

- To assess the short and long-term site specific mitigation and conservation measures to reduce/ reverse land degradation processes, to improve the productivity of land and improve the greenery for sustained livelihood improvement.

- To prepare strategy and design the programme for proper use and improvement of the land, water and forest resources in fulfilling the basic livelihood needs of the population,
- To reduce vulnerabilities to various hazards due to climate change impacts by applying adaptation measures and promote biodiversity conservation;
- To establish linkage between upstream (forest conservation) and downstream communities (settlements and agriculture) for local solution of climate induced disaster;
- To mobilize resources from various organizations to implement integrated watershed management

Integrated Sub-watershed Management Plan (ISWMP) guide the community and watershed professionals on short and long-term planning and implementation of soil, water and biodiversity conservation, climate change adaptation and disaster risk reduction measures in the watershed with active participation of the stakeholders.

4. Scope

The micro-watershed management plan emphasized measures related with:

- The proper / rational utilization of different land uses (mainly agriculture and forest) according to its capability or suitability;
- Improvement of the productivity of the land in perpetuity through appropriate conservation measures while fulfilling the basic needs of the population such as food, fodder, fuel-wood, timber and water;
- Efficient harvesting, conservation and utilization of water resources for drinking, irrigation and other uses;
- Management of available water resources addressing climate change and water induced disaster (drought, flood, and slope failure) related problems by applying proper soil and water conservation measures,
- Mitigation measures to reverse the erosion processes.

5. Planning process and methodology

The Department of Forests and Soil Conservation (DFSC) the than Department of Soil Conservation and Watershed Management (DSCWM) has a comprehensive ‘’Sub-watershed management Planning Guideline-2016’ which has provided a standard template for the sub-watershed management plan. ISWMP of Chhange Khola micro-watershed is prepared under the technical guideline and supervision of Basin Management Centre (BMC), Koshi team in close coordination with Halesi Tuwachung Municipality-11 of Khotang district. Principles, process and methodology described in the guideline are thoroughly followed. The guideline describes the steps/procedures in data collection, analysis to come up with the recommended measures in the management of the micro-watershed resources mainly land, water and vegetation while fulfilling the basic needs of local communities and reducing the land degradation process essential for improving livelihood of people. In addition, climate change impacts, vulnerability to various hazards and disaster risk related data/information were collected using various tools such as social vulnerability mapping, secondary literature and historical records of disasters. Checklist, format, questioners, were prepared before collecting the information. Information was collected by participatory discussion, stakeholder consultation, focus group discussion, and key informant interviews, and field

observation mainly for land degradation mapping. Information thus collected was analysed using Google Earth Pro, Arc GIS, and Microsoft word and excel.

6. General Information

Chhange khola micro-watershed (Fig.6-1) lies in the Halesi Tuwachung Municipality-11 of Khotang district. Geographically it lies between 27^{o} 05' 18" to 27^{o} 06' 50" N and 86^{o} 42' 13" to 86^{o} 43' 44"E. The coverage area of this micro-watershed is about 3.39 Sq.km.

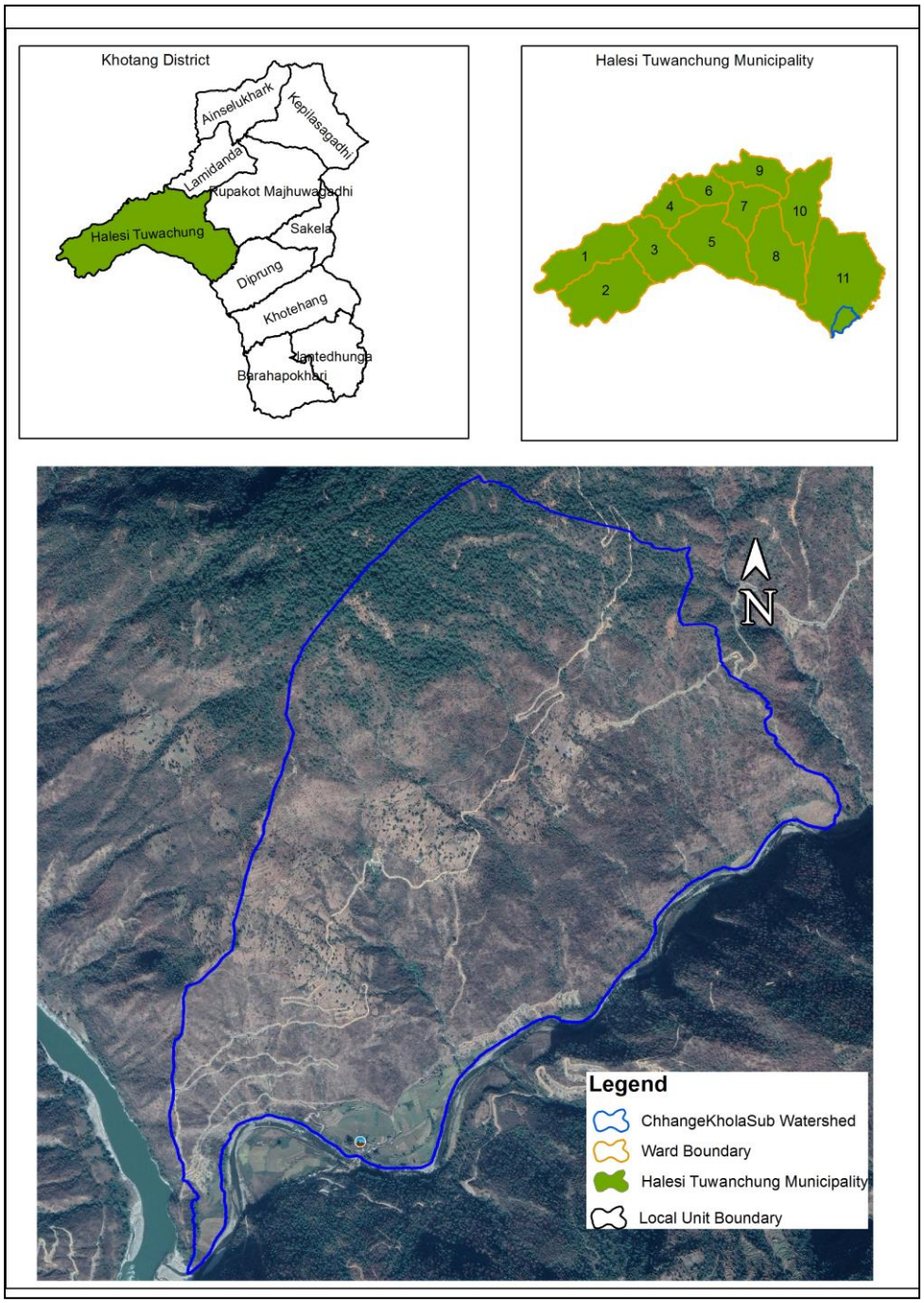

Figure 6-1: Location of Chhange Khola micro waterdshed

7. Topography and Physiography

The micro-watershed falls in the middle mountain physiographic region. The elevation of the micro-watershed ranges from 265 m to 1085 m average mean sea level with mean 637 m. the upper northwest part of the micro-watershed is relatively higher elevated than other part (Fig.7-1).

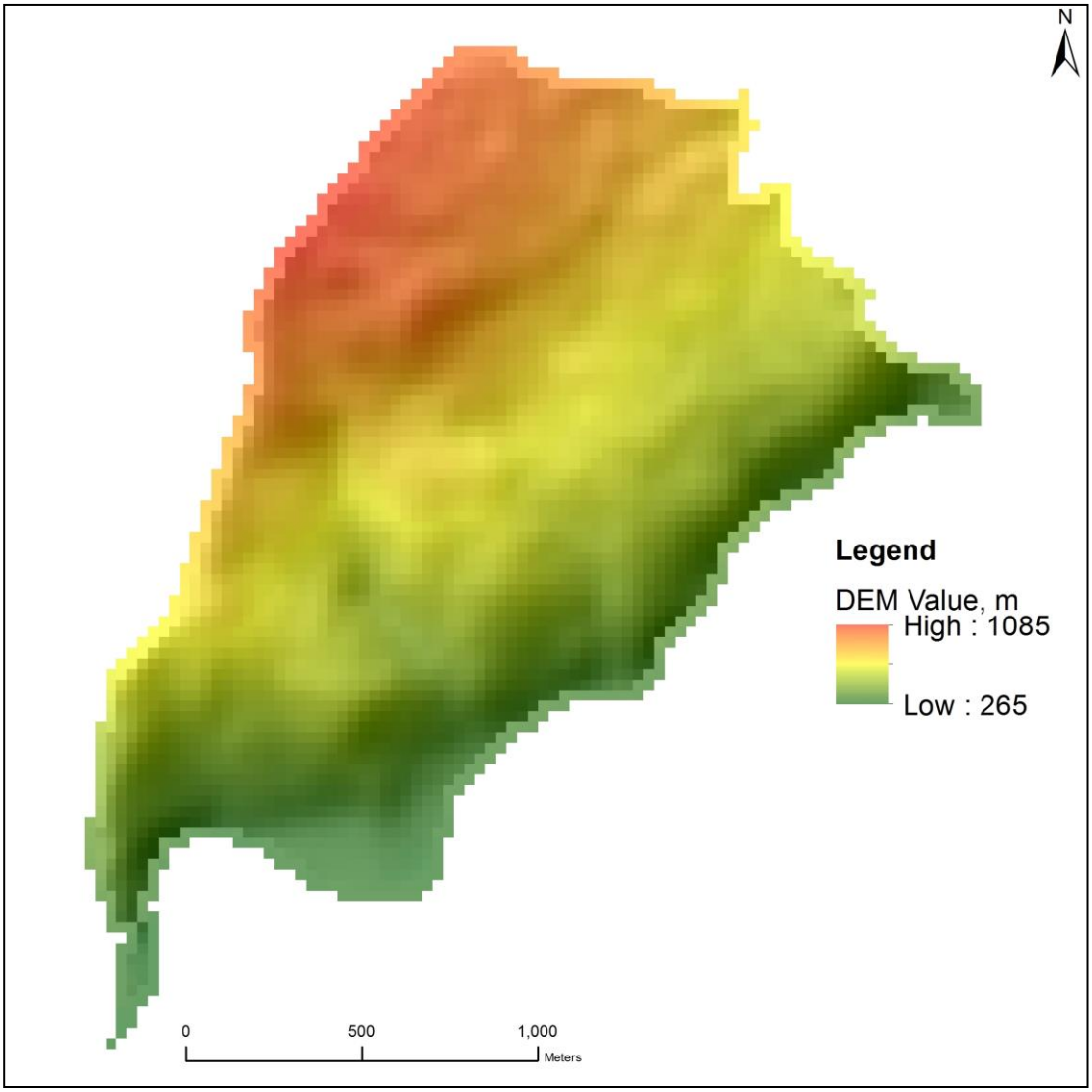

Figure 7-1: DEM of Chhange Khola micro- watershed

8. Elevation

The areal coverage by the various elevation classes has been analyzed and it is observed that about 7.49% area of the micro watershed is covered by elevation class between 500-800 m, followed by elevation class below 500 m, and elevation class above 800 m (Table: 8-1).

Table 8-1: Areal coverage by different elevation classes within Chhange Khola micro-watershed

Elevation Class (m)	Area (km^2)	Area (%)
Below 500	0.96	28.19
500-800	1.64	48.41
Above 800	0.79	23.41

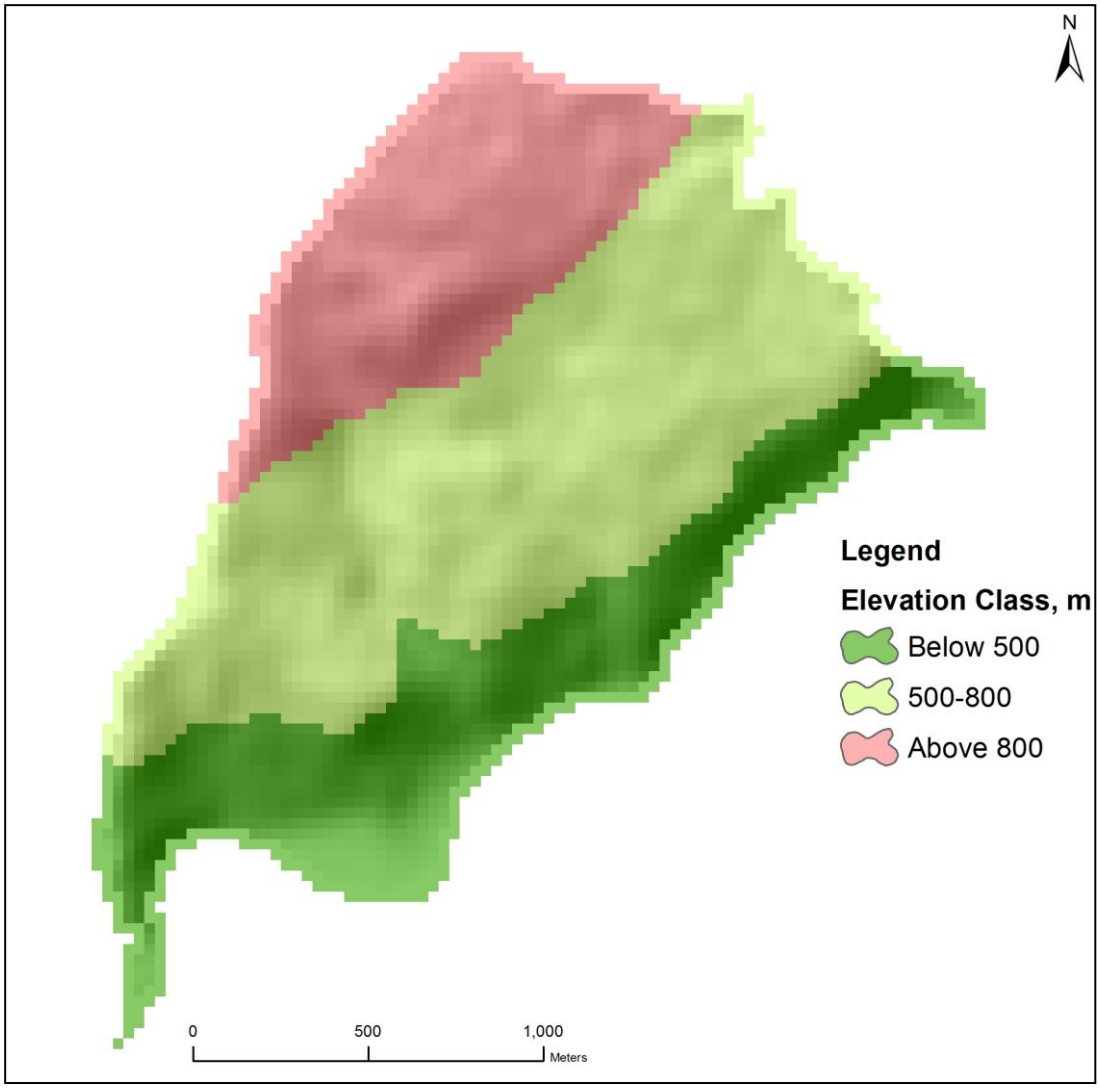

Figure 8-1: Aria coverage of different elevation classes within the Chhange Khola micro-watershed

9. Slope and Aspect

The areal coverage of various classes of the slope has been observed. The middle and upper part of the micro-watershed are steep except some very steep slope while southwest and northeast part of the micro-watershed are very steep slope (Above 60 % slope class). More than 50% area of the micro watershed are steep slope (30-60 % slope class), followed by very steep slope (Above 60%), moderate slope (15-30 % slope class), gentle slope (3-15 % slope class), and the flat area (Table: 9-1; Fig.9-1)).

Table 9-1: Areal coverage by different slope classes within Chhange Khola micro-watershed

Slope Class (%)	Area (%)
0-3	0.72
3-15	3.29
15-30	13.58
30-60	53.13
Above 60	29.28

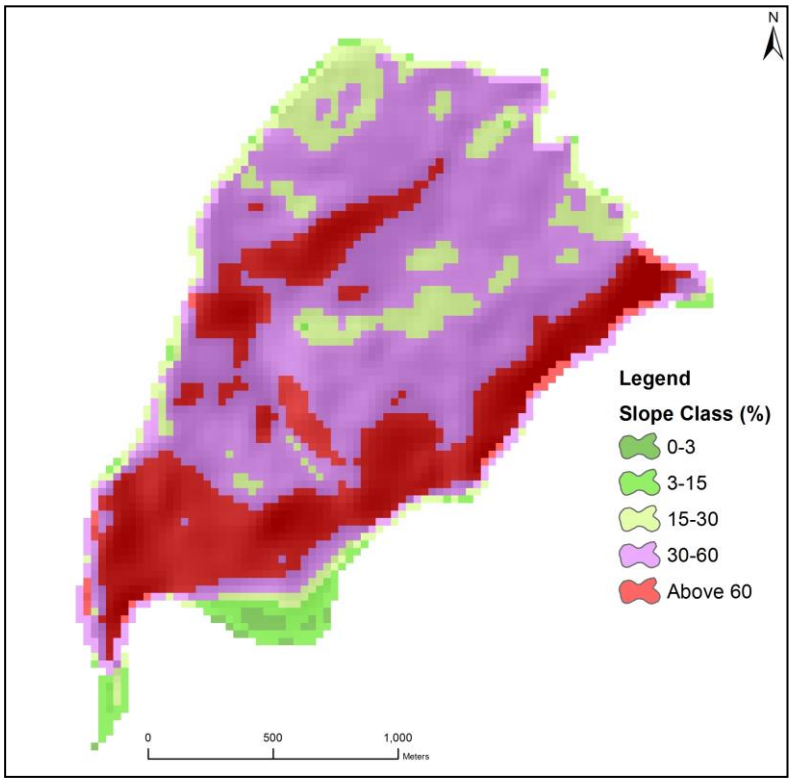

Figure 9-1: Aria coverage of different slope classes within the Chhange Khola micro-watershed

The micro-watershed is predominately of south facing slope. Around 61.08% area of the micro-watershed are south facing slope followed by east facing slope (37.11%), west facing slope (1.2%), and less than 1% east facing slope (Fig.9-2; Table: 9-2)).

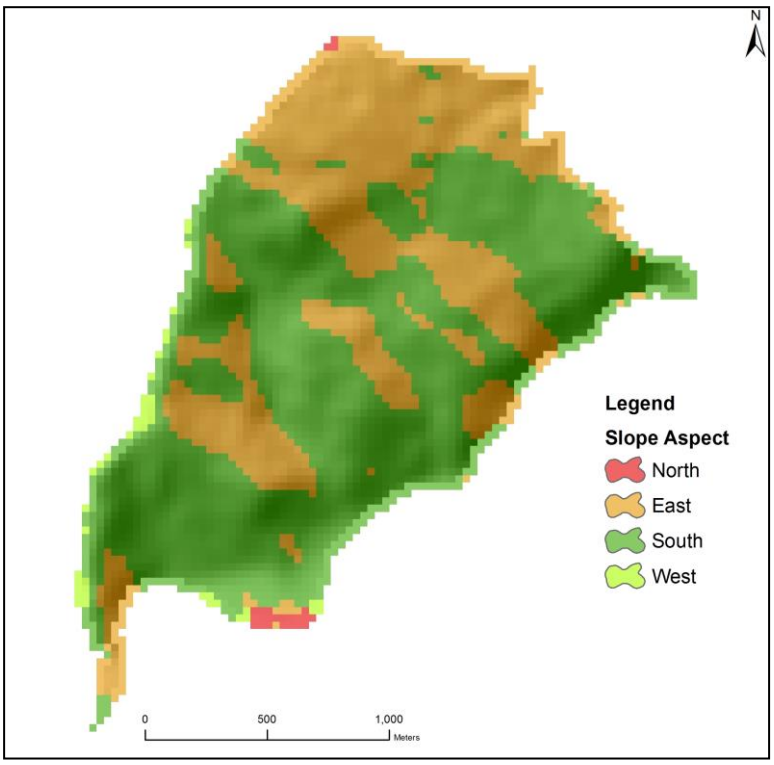

Figure 9-2: Slope aspect within the Chhange Khola micro- watershed

Table 9-2: Slope aspect within Chhange Khola micro-watershed

Slope Aspect Class	Area (%)
North	0.61
East	37.11
South	61.08
West	1.20

10. Hydrology

The Chhange Khola micro-watershed is having numbers of minor drainage line with total length of about 7.9 km. The micro-watershed drains into Sapsu Khola in the south, which is a river system of Sunkoshi River (Fig.10-1).

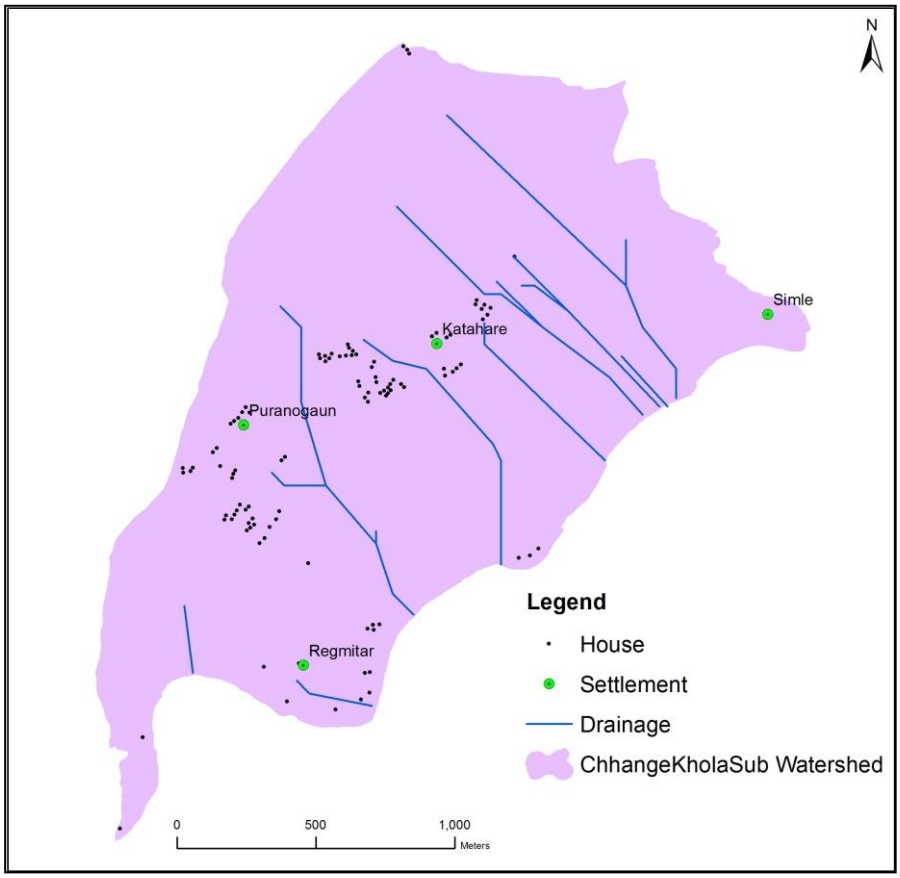

Figure 10-1: Drainage Chhange Khola micro-watershed

11. Climate

The climatic condition of the micro-watershed is differing according to altitudinal differences. The climatic condition is monsoonal type having heavy rain during July to August months. The average annual rainfall recorded at Diktel station during the period of 1995-2014 was 1371.77 mm. The maximum rainfall occurred during 1998 with the annual precipitation of around 1877.60 mm and minimum rainfall occurred during 2005 with the annual precipitation of around 752.90 mm during the period of 1995-2014 (Table: 11-1; Fig.11-1)). More than 80% of the rainfall occurs on the monsoon season. The micro watershed incorporated both tropical regions with experience of hot in summer with maximum temperature of 30 degree and cold in the winter with minimum temperature of 5 degree.

Table 11-1: Monthly rainfall recorded during 1995-2014 at Diktel metrological station (Station No: 1222)

Year	Month											
	Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
1995	0.00	25.70	21.20	44.00	166.60	367.70	390.50	170.40	34.90	0.00	52.00	3.20
1996	15.50	12.30	0.00	16.50	127.00	675.40	404.20	402.70	137.80	0.00	0.00	0.00
1997	16.80	8.00	14.20	227.40	76.40	213.20	316.30	312.30	217.90	30.80	18.00	84.10
1998	13.20	0.00	213.50	391.00	216.00	326.80	497.10	140.00	4.50	71.00	3.50	1.00
1999	0.00	0.00	0.00	214.30	313.70	379.80	211.00	77.10	18.00	0.00	0.00	0.00
2000	0.00	0.00	37.50	274.80	202.40	319.60	228.00	111.00	0.00	0.00	0.00	0.00
2001	18.00	0.00	70.10	273.20	188.80	282.70	264.40	197.20	102.00	0.00	0.00	21.70
2002	12.50	37.30	67.00	69.20	283.30	411.20	249.00	155.00	31.80	44.50	69.00	13.30
2003	25.60	49.80	55.80	38.50	223.90	264.20	113.20	57.80	29.80	0.00	0.00	33.30
2004	27.90	10.80	65.00	113.40	55.50	242.30	125.60	109.10	15.90	0.00	0.00	28.70
2005	0.00	86.70	43.70	103.00	136.90	83.40	244.90	37.50	16.80	0.00	0.00	0.00
2006	0.00	20.40	21.80	204.20	359.50	266.50	76.30	233.10	0.00	18.50	0.00	0.00
2007	45.30	0.00	68.60	134.30	121.10	377.50	317.00	288.50	88.50	3.30	0.00	10.30
2008	0.00	33.10	24.20	245.30	536.40	443.30	300.20	92.10	45.00	0.00	0.00	0.00
2009	0.00	31.10	129.80	222.50	101.80	309.70	514.70	79.00	11.50	0.00	7.00	0.00
2010	10.50	27.60	92.70	287.50	103.40	440.50	431.50	233.80	57.90	0.00	0.00	11.80
2011	17.00	26.10	164.10	192.00	375.60	476.20	429.30	254.80	31.00	46.50	0.00	10.50
2012	8.60	6.70	60.20	181.60	232.10	329.10	332.10	205.40	6.60	0.00	0.00	8.50
2013	44.20	5.50	0.00	251.50	305.80	285.70	233.50	0.00	0.00	0.00	0.00	0.00
2014	21.30	19.50	18.50	256.70	225.10	203.70	319.90	199.30	0.00	0.00	0.00	4.50

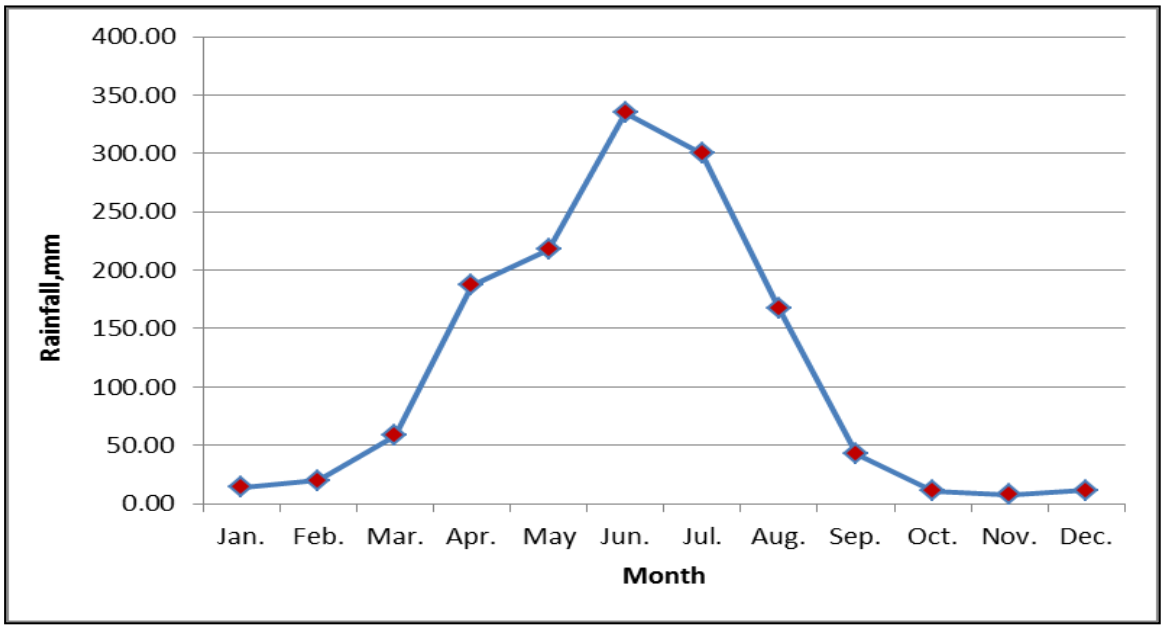

Figure 11-1: Average Monthly rainfall (mm) pattern as measured at Diktel meteorological station during 1995-2014

12. Road Network

The road network within the micro-watershed is about 9.51 km including of district road 2.26 km and highway 7.25 km. The Maure-Foksingtar highway passes from lower part of the micro watershed through Simle settlement. Likewise, Dhitung-Regmitar, and Diktel-Khanidanda-Regmitar district passes through Puranogaun and Katahare settlement (Table: 12-1; Fig. 12-1).

Table 12-1: Road network within Chhange Khola micro-watershed

Road Class	Length (km)
Highway	7.25
District Road	2.26
Total	**9.51**

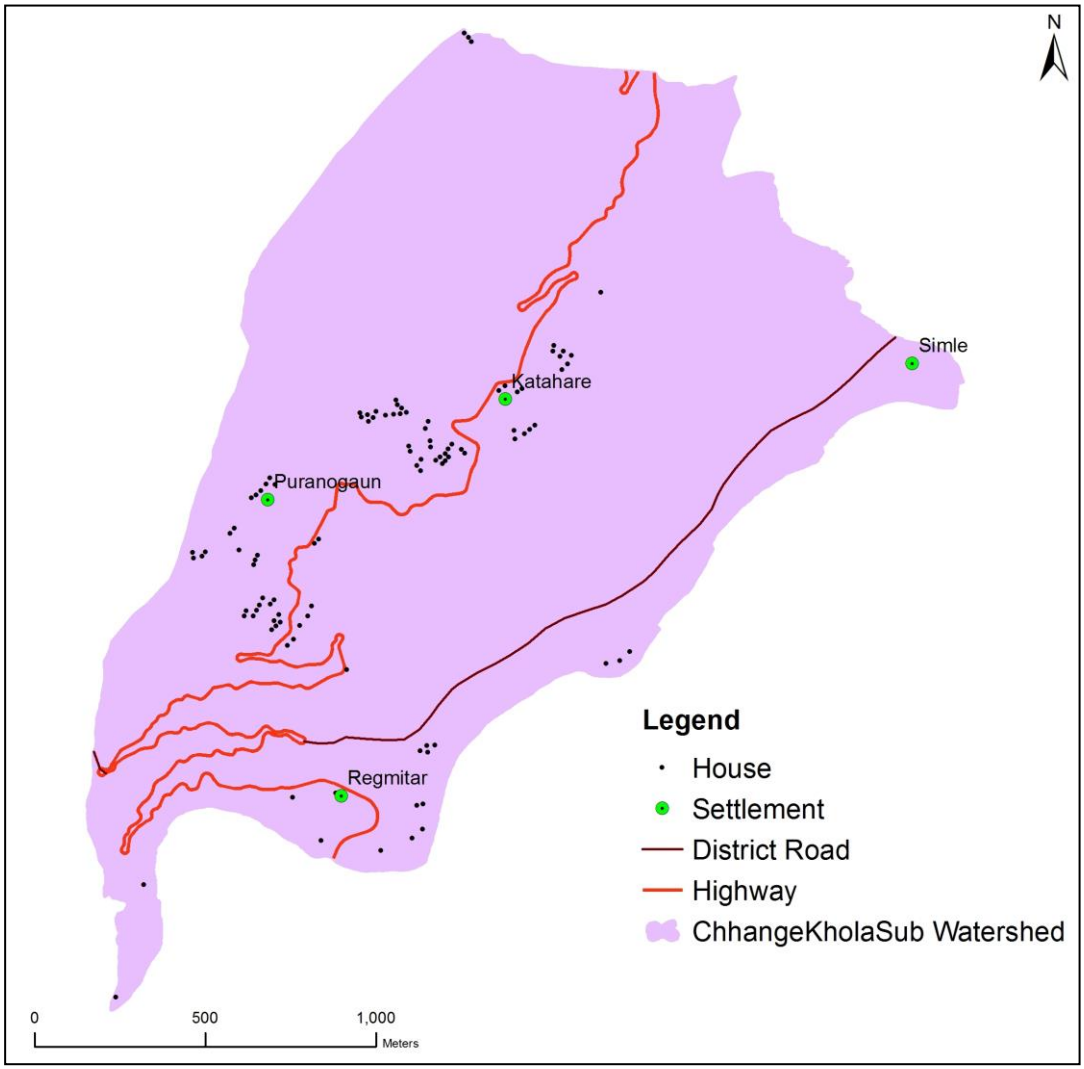

Figure 12-1: Road network within the Chhange Khola Micro-Watershed

13. Land System and Soil

The micro-watershed comprise with three land system including of alluvial plains and fans (depositional), moderately to steeply sloping mountainous terrain, and steep to very steep sloping

mountainous terrain. Most of area of the micro-watershed is dominated by steeply to very steeply sloping mountainous terrain (Table: 13-1; Fig. 13-1).

Table 13-1: Land system within Chhange Khola micro-watershed

Land System	Area (ha)	Area (%)
Steeply to Very Steeply Sloping Mountainous Terrain	255	75.29
Moderately to Steeply Sloping Mountainous Terrain	36	10.76
Alluvial plains and fans (depositional)	47	13.95

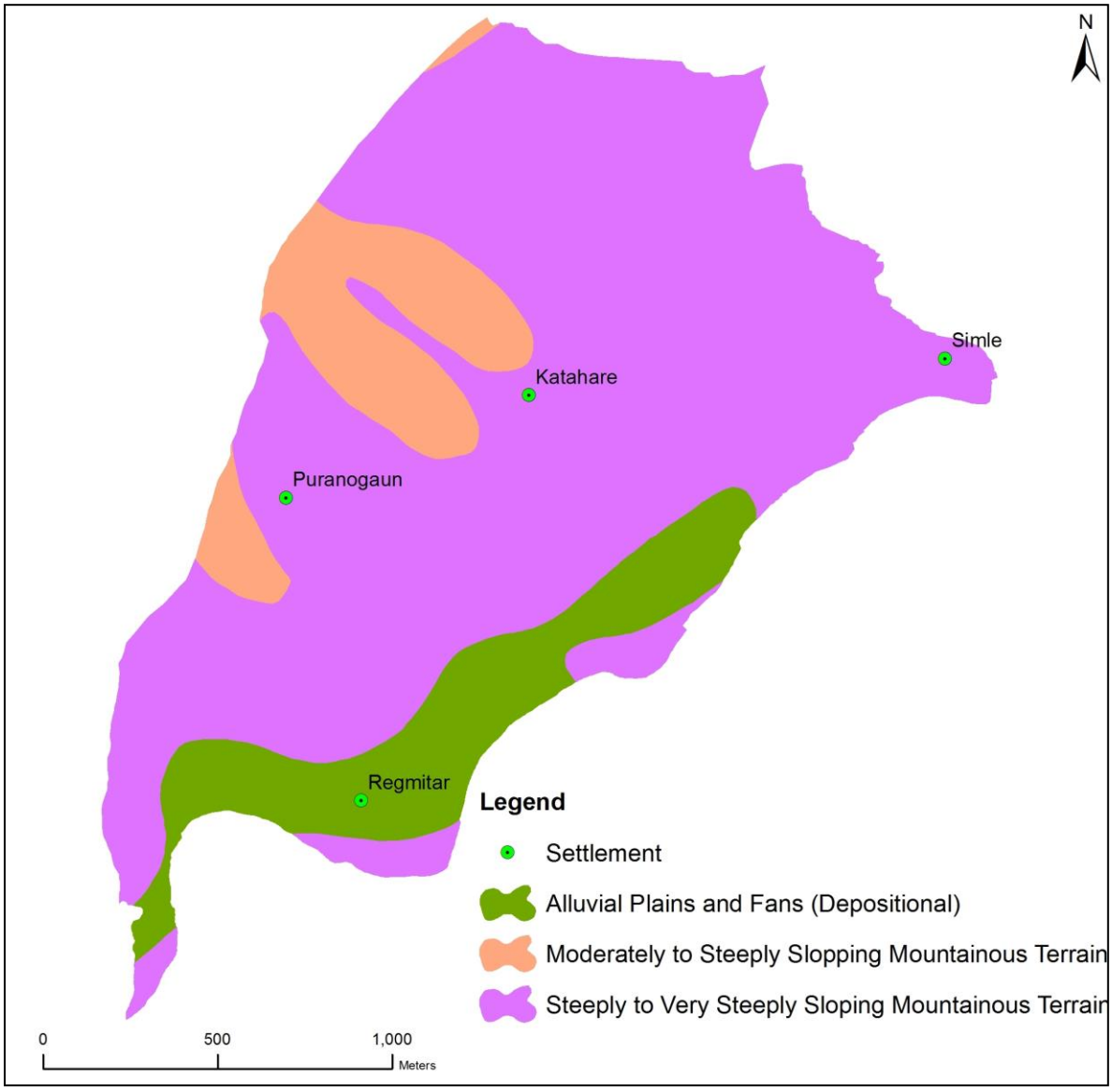

Figure 13-1: Land system within the Chhange Khola Micro-Watershed

The micro-watershed consists of four types of soil including of Lithic Microgroups of II & Ustorthents, Typic, Rhodic,Udic,Anthropic,Microgroups of Ustochre, and Ustochrepts Haplustalfs, with loamy skeletal and loamy boulder soil texture (Table: 13-2, 13-3; Fig. 13-2).

Table 13-2: Soil type within Chhange Khola micro-watershed

Soil Type	Area (ha)	Area (%)
Lithic Microgroups of II & Ustorthents	259	76.40
Typic, Rhodic,Udic,Anthropic,Microgroups of Ustochre	38	11.21
Ustochrepts Haplustalfs	42	12.39

Table 13-3: Soil texture within Chhange Khola micro watershed

Soil Texture	Area (ha)	Area (%)
Loamy Skeletal	292	86
Loamy/Bouldery	47	14

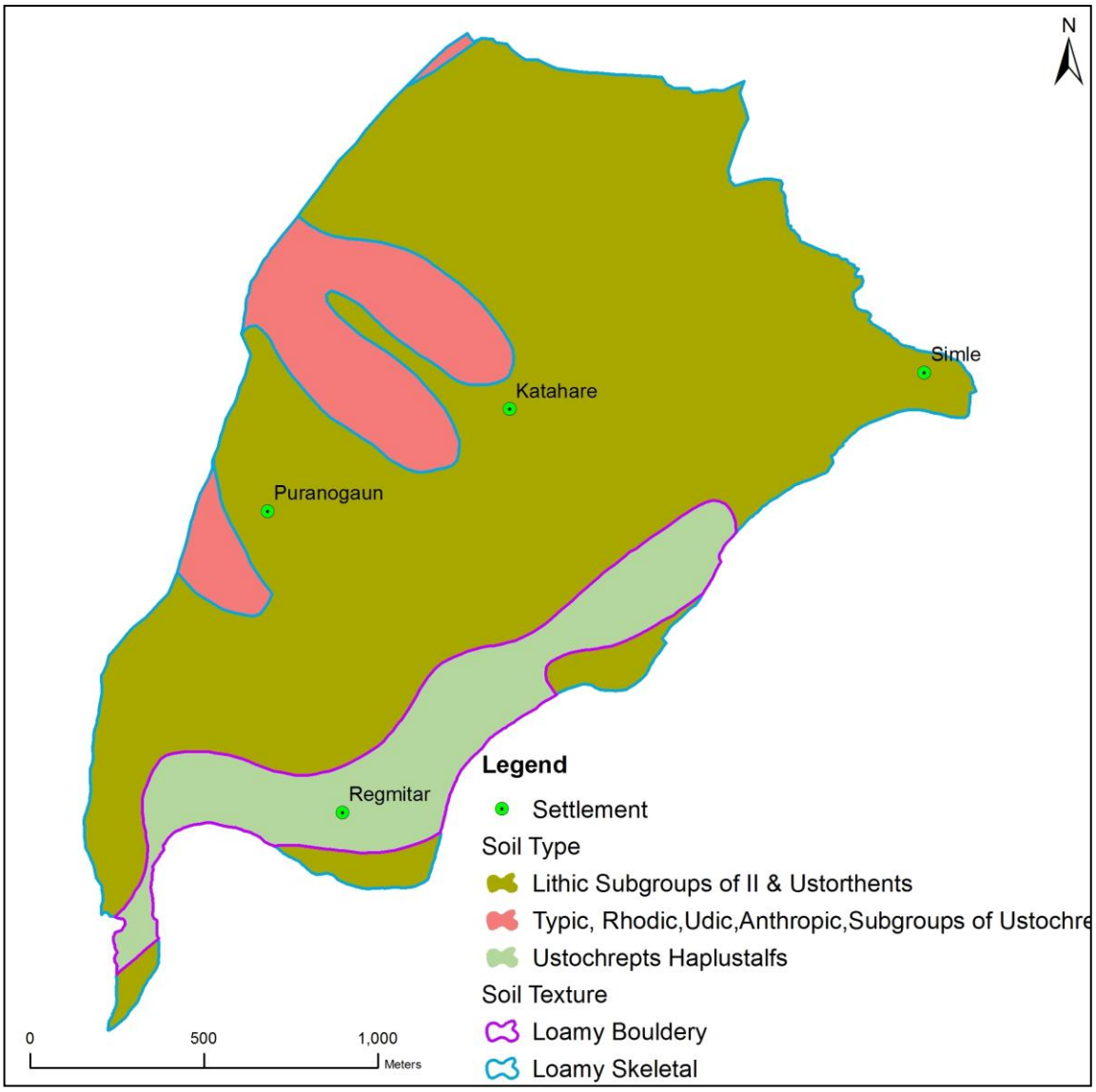

Figure 13-2: Soil type and soil texture within the Chhange Khola Micro Watershed

14. Land Use

Agriculture is most dominant land use in this micro watershed. The land use pattern shows that about 91.37% of the total micro watershed area is covered by agriculture land, followed by forest coverage (6.91%), grassland (1.67%), and negligible amount of barren land (Table: 14-1; Fig. 14-1).

Table 14-1: Land use and land cover within Chhange Khola micro-watershed

Land Use/Land Cover Class	Area (ha)	Area (%)
Agriculture	309.74	91.37
Forest	23.41	6.91
Grassland	5.67	1.67
Barren Land	0.18	0.05

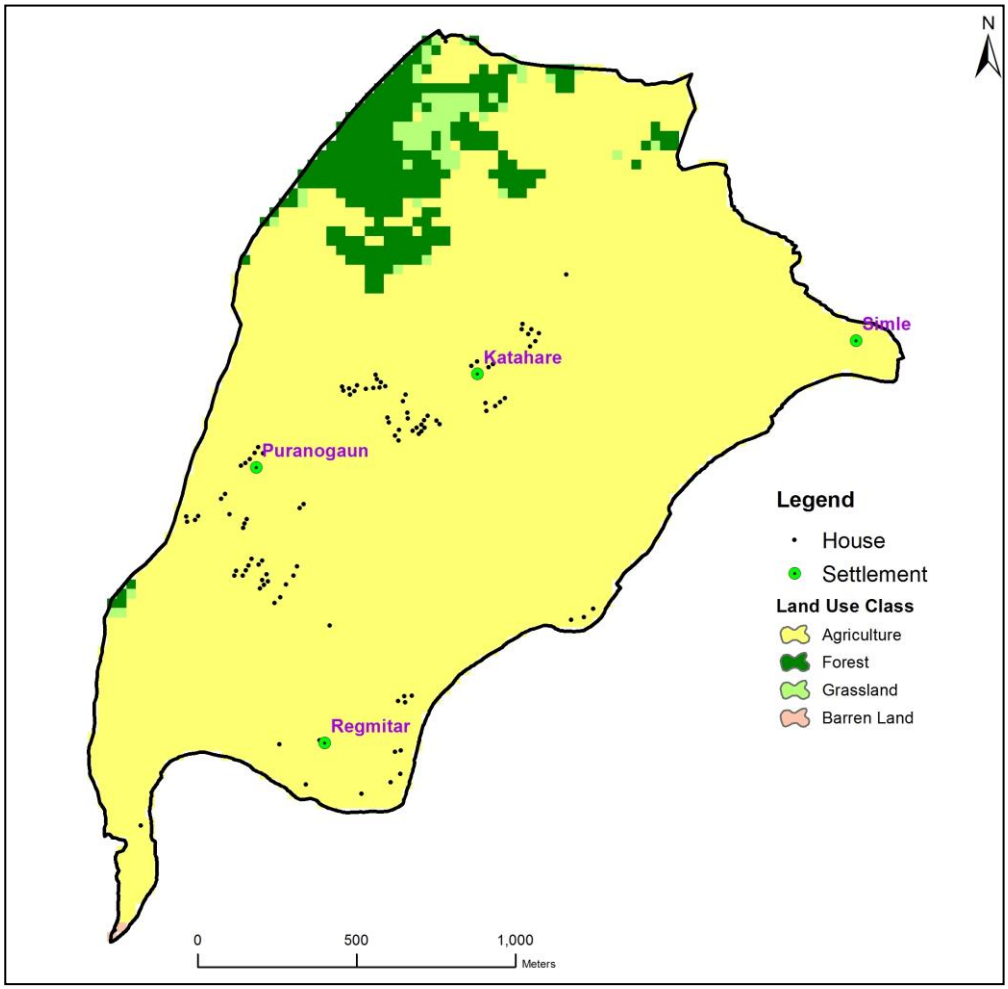

Figure 14-1: Land use and land cover within the Chhange Khola micro-watershed

15. Socio-economic Condition

Demographic Setting

The micro-watershed is having of 39 households with the total population of 191 including of male 116 and female 75. The population of below 16 years age group is about 27%, and the population between 16 to 60 years age group is about 73%. The micro watershed is mostly dominant of Chhetree and Rai cast

and ethnic group. Almost population belongs to Hindu religion however there are Buddhist and Christian follower too.

Education

The literacy rate of the micro watershed is about 40% in which male literacy 50% and female literacy 30%. There is one lower secondary school. For higher level education, people of this micro- watershed travel to nearby places and Diktel.

Health Service

Health condition of this community within the micro-watershed is quite good although lack of health care center within micro watershed. People have to travel nearby ward of municipality or nearby cities for better health facilities.

Drinking Waters and Sanitation

There is one drinking water user group community named Masane Khola Drinking Water User Group for supply and management drinking water facility to the community within the micro-watershed. Besides, people are using well/Kuwa and river streams as alternative sources for drinking water.

As for sanitation condition, almost all houses have own toilet facility with ordinary type. All the houses dump their garbage at own field.

Source of Energy and Communication

Almost houses usages firewood as major source for cooking however LP gas is also in use but very low volume. For the lightening, houses are using electricity. The communication within the micro watershed is fairly good in which people are using both NTC and Ncell network for mobile. Almost houses have access to Television with cable connected.

Socio-economy and Livelihood

Agriculture is the primary source for the livelihood however it is just sustain for not more than 6 months. Besides, people are engaged in different types of occupation such as livestock farming, and services at government office.

16. Agriculture Condition

Major Crop

Rice, Maize, Wheat, Mustard, Barley, Millet and Potato are the major crops growing within the micro watershed. Besides, people are also engaged on bee keeping farming and fruits farming such as mango, guava, papaya, pomegranate and litchi. Rice, wheat, mustard, and potato are grown in the wet land, and maize and millet are grown in the dry land. As dependency and survival from agriculture production, about 19% families survive up to three months, 51% families sustain up to six months and about 30 % families survive up to nine months.

Fruits and Vegetables

Mango, guava, litchi, papaya and pomegranate are common fruits in practice within the micro watershed area. Likewise, tomato, and green chilly are common vegetable in practice.

Irrigation Facility

The micro watershed area has irrigation facility for more than 280 ropani agricultural land through three irrigational cannels, although these irrigation cannels require of maintenance. Some of the agriculture lands are rain fed which are depending on monsoon due to not excess of irrigation facility.

Fertilizer and Pesticide

The community usages both cow dunk and urea fertilizer in the agriculture land. According to local, among the usage of the fertilizer, about 60% is cow dunk and remaining is urea. There is no use of pesticide on the crop.

Farmed based and other economic activities

Cow, buffalo, pig, and goat are common livestock framing in the micro watershed region as farm based activities which are for the domestic purpose. Similarly, bee keeping is another farm based activity found in the region.

Agriculture Potentiality

- Fruit Farming: Mango, Guava, Pomegranate, Lemon
- Livestock Farming: Cow, goat, and poultry
- Bee Keeping
- Vegetable Farming: Tomato, Green Chilly

17. Forest and Biodiversity

The micro-watershed area have less coverage of forest (nearly 7%) with the mixed of different type plant species. this forest is governed by community forest named Mahankala Community Forest. Pine, Sal and Khayar are common plants found in the forest.

18. I/NGOs and CBO

There are four organizations including of one non-government organizations, one drinking water user group, one community forest user group, and one agriculture group. Apart from these, there was no other organization found at present (Table: 18-1).

Table 18-1: I/NGO and CBO within Chhange Khola micro-watershed

S.N.	Organization	Location	Working Area
1	Masane Khola Drinking Water User Group	Okhake Tole	Drinking Water Management
2	Mahankala Community Forest User Group		Community Forest Management
3	Pariwartan Yuba Samaj	Chapleti	Building Construction
4	Paruhang Krishak Group	Chapleti	Irrigation Management

19. Analysis of Problem

19.1 Physiographic Problem

The growing population with the increasing demands for food, fodder, and shelter (wood) is putting pressure on acquiring more agricultural land and promote for deforestation and encroachment within the micro-watershed. This resulting encourages marginal land cultivation, intensification of agriculture, overgrazing, and illegal logging activities at recent time. These in turn degrade the agricultural land as well as the forests and grazing land which further leads to soil degradation and reduces the carrying capacity of the land.

Around 29.28% of the land is above 60% slope class, where isolated agriculture practices need to be strongly discouraged and complete protection of national and community managed forests is recommended. Likewise, about 53.13% of the land is between 30 to 60% slope class, which with intensive conservation measures can be used moderately for agriculture only if they are currently under agriculture/ agro-forestry land use. In case of Chhange Khola micro-watershed, this is also the area where most of forest areas lies but is also undergoing degradation. Encroachment into these slopes should be prevented. Similarly, about 13.58% land ranges between 15-30% slopes class, which can be used for agriculture with moderate conservation measures. Around 4% of the land ranges from flat to gentle slope (up to 15% slope class), which can be optimally used with appropriate conservation measures.

Aspect is important for vegetation management and on farm conservation. Northern aspect contains more moisture than southern and southern aspect expose to sun which are favourable for cultivation. About 61% land area of the micro watershed are south facing whereas nearly 1% area are north facing slopes. Some plant species plantation or management need to plan according to aspect. Same applies for horticulture/fruit tree plantation. Information about the aspects of the micro-watershed is shown in table 9.2 and figure 9.1.

The general findings and assessments for the district as per Climate change vulnerability mapping carried out by MoE (2010) the Khotang district has considered as very low risk of flood vulnerability however the lower region of the Chhange Khola micro-watershed is highly risk of flood from the Sapsu Khola. Likewise, MoE (2010) revealed that the Khotang district is ranked moderate landslide vulnerability. The practices of unscientific cultivation on hill slope increasing the degrading land couple with potential landslide and mass movement activity. The increasing trend of floods and landslides in the area result in decrease of cultivable lands, loss and damage of crops. This trend of increasing degraded land result decrease in agricultural areas leads to encroachment of surrounding forests and marginal lands which further deteriorate the health of the micro-watershed.

19.2 Resource Use Problems

Forests, land and water are the key resources use for producing people's basic needs such as food, fodder, fuel wood, timber and water. Therefore, for designing proper programme and strategies in fulfilling the basic needs without degrading the resource base, it is important to analyze the supply demand status of these basic needs

19.3 Food Status

Paddy and wheat are the two main cereal crops cultivated in the wet land areas of the micro watershed whereas maize is cultivated in dry lands. Millet, mustard and potato is also cultivated but not at a

significant scale. Analyzing the food production and food requirement in term of cereal value, the micro-watershed has a food deficit of cereals.

19.4 Fodder Status

Community indicates that fodder species plantation is less exercised in the community and could be a potential activity under the on-farm conservation intervention in the sloping agriculture lands to reduce pressure on surrounding forests. Though the watershed is not rich in forest resources, a large section of forest is inaccessible/ distant for daily fodder/ litter use for communities. Free grazing is practiced in the micro watershed. In order to reduce the dependency on forest fodder, it is urgently need to plantation of trees/grass at riverside. Fodder species plantation is less exercised in the community and could be a potential activity under the on-farm conservation intervention in the sloping agriculture lands to reduce pressure on surrounding forests.

19.5 Fuel wood Status

About 7% area is covered by forest which is managed by community forest. Most of the people are relied on this community forest for fuel wood however it is not enough to fulfill the demand of the community. So, there is a need of afforestation program and activity to maintain the dependency on fuel wood.

19.6 Water Need Status

Water for drinking and irrigation are two major needs of the rural community. There is no alternative to this need. Main water sources, their status and potential intervention/activities for protections were identified during filed observation, discussion, and upstream and downstream engagement and strengthening workshop. Dasmure, Simpane, and Regmitar irrigation systems are existent in the catchment and are of prime importance to local economy. Maintenance of these systems is a priority and these systems are frequently disrupted and damaged by landslides and floods. Likewise, existing drinking water supply activity need to upgrade with establishment of water tank to address future demand.

19.7 Socio-economic Problem

- Lacking of income generation activity-based training
- Lack of employment opportunities
- Supporting for Agriculture base farming
- Flood and Inundation at Lower Belt and impact on social mobilization as well as losses of crops
- Lack of gender and class participation
- Lack of disaster management awareness and practices
- Indigenous seed varieties are being threatened due to overspread of high yielding verities
- Lack of human resources in agricultural
- Lack of health post within the community
- Lack of public awareness and participation on conservation of water resources
- Lack of market security for agricultural production

20. Major Problem and Issue

The major problem and issue related to the Chhange Khola micro-watershed were identified during the field visit and interaction with the local community. The identified problem and issues have been presented in below table (Table: 20-1).

Table 20-1: Major problem and issues within Chhange Khola micro-watershed

S.N.	Problem/Issue	Location	Affected/ Benefitted HH	Affected Land	Activity to be Applied
1	Jante Landslide	Jagarevir, ward-11	6	4 ha	Gabion wall protection
2	Aapdanda Erosion	Aapdada, khola, ward-11	14	1 ha	Prevention
3	Dhukepani Erosion	Changakhola, ward-11	20	1 ha	Prevention
4	Dasmure Irrigation Cannel (1 km)	Dasmure	15	60 ropani	Need RCC Intervention
5	Simpane Irrigation Cannel (500 m)	Simpane	12	40 ropani	Need RCC intervention
6	Regmitar Irrigation Cannel (1 km)	Regmitar	60	180 ropani	Need RCC intervention
7	Sindhure Khola Protection (100 m)	Chapleti	28		Need Protection activity
8	Ghumaune Danda Khola (100 m)	Chapleti	28		Need Protection activity
9	Conservation of Kirat Tallo Padhero	Chapleti	24	5 sq.km	Reconstruction and extraction of aggradation material
10	Conservation of Danda Pokhari	Chapleti	24	162 sq.km	Maintenance and conservation activity
11	Haatpare Pokhari	Chapleti	24	128 sq.km	Maintenance and conservation activity
12	Foot Trail	Jagatevir to School	10	1km	Maintenance
		Chipleti to Jagare vir	20	1 km	Maintenance
		Road padheri	14	500 m	Maintenance

S.N.	Problem/Issue	Location	Affected/ Benefitted HH	Affected Land	Activity to be Applied
		Chapleti to Regmitar	25	1 km	Maintenance
13	Road Side (Sadak Pakha) Conservation	Chipleti	40	4 km	Conservation road side with cleaning and plantation
14	Plantation at Mahankala Community Forest		All households		Plantation of salla, sal, khayer, Harro, Barro etc.
15	Conservation of spring	Mathilo Kirat Padhero, Chapleti	28	1 ropani	Maintenance
		Tallo kirat Padhero, Chapleti	28	1 ropani	Maintenance
		Masanekhola Drinking Water Spring, Rajarani Chapleti	200	10 km	Proper management of pipeline
		Aapkhola Drinking Water Spring	100	5 km	Conservation and Proper management
16	Support and promotion for tunnel farming	Chapleti	10		Providing plant species, equipment, and Training
17	Support and promotion for chilli farming	Chapleti	10		Providing plant species, and Training
18	Support and promotion for goat farming	Chapleti	10		Economic support for goat farming, and provide goat kids
19	Agriculture land Rehibialiation	Bagar	4		Reconstruction
		Dasmure	15		Reconstruction
		Simpane	10		Reconstruction
20	Support for Plantation fruits	Ward no.11	All housesholds		Providing fruit species, Training
21	Awareness Programe and activity				Conduct awareness campaign regularly in the field of education, environment, cleaning and hygiene, and provide skill

S.N.	Problem/Issue	Location	Affected/ Benefitted HH	Affected Land	Activity to be Applied
					based training
22	River Bank Conservation	Sapsu khola, Dasmure	8	300 m	Cutting Protection, Proper Management of River Bank
		Aapghari khola, Simpane	3	100 m	Cutting Protection, Proper Management of River Bank
		Bagar khola, Bagar	20	400 m	Cutting Protection, Proper Management of River Bank
23	Change of wooden electricity pole				Need to replace of wooden pole

21. Proposed Conservation Programme

21.1 Land Use Recommendation

In the present context, there are no agricultural lands in slopes above 60% and this should be maintained in the future. For all other slope classes, appropriate land use recommendations are provided in the table below and should be properly followed. A large portion of agricultural land in the catchment lies along the slopes within the micro watershed. Few isolated encroachments along the slopes and ridges should be avoided as far as possible. Cultivation lands along the valley floors and gentle slopes of less than 30% can be intensively cultivable with moderate needs for soil conservation mainly maintenance of drainage and terracing. The moderate slopes between 30-60% are cultivable with intensive soil conservation measures mainly terrace maintenance and proper channelization of drainage water. Any area above 60% slope should be avoided for cultivation except of perennial fruit trees.

Similarly, the micro-watershed has less forest coverage. About 7% of the total slopes area of the micro-watershed are covered by forests and somehow providing a cover against landslides and erosion. Forests on gentle to moderate slopes of less than 30% slope class can be used as production forests but with adequate care that it does not trigger any mass movements along the slopes or near to river beds which can lead to toe-cutting. Forests along slopes between 30-60% can be used optimally with adequate conservation measures in place and proper cultural operations. Most of the forest area is under community management and this should be promoted further. Forest areas in slopes above 60% should be used with utmost care and largely as protection forest. Very limited cultural operations such as; removal of dead, decaying and mature trees is recommended without affecting the surrounding vegetation so that it does not trigger slope failures and mass movements (Table: 21-1: 21-2).

Table 21-1: Proposed land use for agriculture land within Chhange Khola micro-watershed

Slope (%)	Conservation need for against cultivation
0-3	Intensively cultivated land, with some need for soil conservation. In river valley flood control and drainage may be needed. Organic matter in the soil need to be maintained for the productivity

3-15	Intensively cultivated land, with moderate need for soil conservation e.g. levelling and safe disposal measures. In river valley flood control and drainage may be needed. Organic matter in the soil need to be maintained for the productivity
15-30	Cultivated land. Terracing is needed in combination with moderate agricultural conservation practices, water control, maintenance of terraces etc. Organic matter in the soil need to be maintained for the productivity.
30-60	Cultivated land. Terracing is essential in combination with intensive agricultural conservation practices. Terrace maintenance and proper disposal of drainage water must be undertaken.
Above 60	No cultivation due to very steep slope and very high-water logging.

Table 21-2: Proposed land use for forest land within Chhange Khola micro-watershed

Slope (%)	**Symbol**	**Conservation need for against forest**
0-30	PDF	Production forest. Intensive forest management with some conservation measures for optimal use.
30-60	LUF	Limited use forest. Moderate forest management with moderate conservation measures is recommended.
Above 60	PRF	Protection forest. Permanent forest protection with wise use of forest resources (e.g. removal of old dead, dying trees) to protect water sources and to prevent soil erosion in needed.

21.2 Logical Frame Work

The logical frame work has been developed with emphasizes of required activities for the sustainable micro watershed management. The detail proposed activity is presented in table 21.3.

Table 21-3: Logical framework for proposed conservation programme

S.N.	Conservation Measures		Unit	Quantity	Means of Verification	Important Assumption	Output as per govt. approved Log-frame
1	**Sustainable Land Management**		Component Purpose: To increase the productivity of land on sustained basis and to increase biodiversity				
1.1.	Degraded land rehabilitation (Rehabilitation of degraded lands)						
1.1.1.	DLA	Degraded Land Rehabilitation Agriculture land			Physical progress Report (PPR)	Complete package activity will be implemented	P1O3 Increased conservation farming practices
1.1.2.	DLF	Degraded Land Rehabilitation Forest land			PPR	Complete package activity will be implemented. Vegetative measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.	P1O1/P201: Increased ground coverage of the watershed P1O2 Increased crown coverage of the watershed P202: Improved land husbandry of upland areas P204: Increased adoption of proper land use practices according to the land capability classification P108: Increase water holding capacity in the watershed P206: Increased bio-mass production of marginal lands P509: Enhanced people's participation in SCWM
1.1.4.	PrB	Protection barren land			PPR	Complete package activity will be implemented. Vegetative measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.	P1O1/P201: Increased ground coverage of the watershed +R[17]CP1O2 Increased crown coverage of the watershed P202: Improved land husbandry of upland areas P204: Increased adoption of proper land use practices according to the land
SCWM							

1.5.	FTP	Fruit tree plantation			PPR	Complete package activity will be implemented. Vegetative measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.	P1O1 Increased ground coverage of the watershed P1O2 Increased crown coverage of the watershed P104 Increase adoption of proper land use practices as per land capability classification. P108: Increase water holding capacity in the watershed P202: Improved land husbandry of upland areas P206: Increased bio-mass production of marginal lands P509: Enhanced people's participation in SCWM
1.6.	FGP	Fodder / Grass plantation			PPR	Complete package activity will be implemented. Vegetative measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.	P1O1 Increased ground coverage of the watershed P1O2 Increased crown coverage of the watershed P104 Increase adoption of proper land use practices as per land capability classification. P108: Increase water holding capacity in the watershed P202: Improved land husbandry of upland areas P206: Increased bio-mass production of marginal lands
P509: Enhanced people's participation in SCWM							
1.7.	CPl	Conservation plantation			PPR	Complete package activity will be implemented Emphasized vegetative measures Maintenance activities will be continued. Beneficiaries will be involved in maintenance	P1O1 Increased ground coverage of the watershed P1O2 Increased crown coverage of the watershed P104 Increase adoption of proper land use practices as per land capability classification. P108: Increase water holding capacity in the watershed P202: Improved land husbandry of upland areas

							P206: Increased bio-mass production of marginal lands P509: Enhanced people's participation in SCWM
1.10.	SWM	Safe water management (Level Terrace)			PPR	Complete package activity will be implemented, Maintenance activities will be continued,	P1O9 Prevented landslides/ gullies formation and river/stream bank cutting P509: Enhanced peoples participation in SCWM
2	**Disaster Risk Reduction and Natural Hazards Management**				**Component Purpose: To protect and live and property from the reduce the water induced disasters**		
2.1.	LST	Landslide treatment			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued.	P1O1/P201: Increased ground coverage of the watershed P1O5 Increased the number of stabilized landslides and gullies P509: Enhanced people's participation in SCWM
Beneficiaries will be involved in maintenance. Disastrous rain will not be occurred.							
2.3.	GuT	Gully treatment			PPR	Complete package activity will be implemented Bio-engineering measures will be emphasized Maintenance activities will be continued. Beneficiaries will be involved in maintenance Disastrous rain will not be occurred	P1O1/P201: Increased ground coverage of the watershed P1O5 Increased the number of stabilized landslides and gullies P509: Enhanced peoples participation in SCWM
2.4.	ToC	Torrent control			PPR	Complete package activity will be implemented Bio-engineering measures will be emphasized Maintenance activities will be continued. Beneficiaries will be involved in maintenance Disastrous rain will not be occurred	P1O7 Increased the number of tamed torrentsP509: Enhanced peoples participation in SCWM

2.5.	RBP	River bank protection			PPR	Complete package activity will be implemented Bio-engineering measures will be emphasized Maintenance activities will be continued. Beneficiaries will be involved in maintenance Disastrous rain will not be occurred	P1O6 Increased the length of stabilized river / stream banks P509: Enhanced peoples participation in SCWM
2.6.	SBP	Stream bank protection			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance. Disastrous rain will not be occurred.	P1O6 Increased the length of stabilized river / stream banks P509: Enhanced peoples participation in SCWM
3	**Water and Sediment Management**						
3.1.	**Water Harvesting**						
3.1.1.	CoP	Conservation Pond			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance. Climatic calamities (such as disastrous rain and drought) will not be occurred.	P108: Increase water holding capacity in the watershed P1O11 Increased water yield through water harvesting P509: Enhanced peoples participation in SCWM
3.1.2.	CoD	Conservation Dam			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance. Climatic calamities (such as disastrous rain and drought) will not be occurred.	P108: Increase water holding capacity in the watershed P1O11 Increased water yield through water harvesting P509: Enhanced peoples participation in SCWM
3.1.4.	CoB	Contour bunding			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance. Climatic calamities (such as disastrous rain and drought) will not be occurred.	P1O10 Trapped sediment upstream P108: Increase water holding capacity in the watershed P509: Enhanced peoples participation in SCWM

4	**Development Infrastructure Protection**						
4.1.	ICP	Irrigation channel protection			PPR	Complete package activity will be implemented. Bio-engineering measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance. Disastrous rain will not be occurred.	P3O2 Increased the number of stabilized /protected irrigation schemes, drainage, and water source P509: Enhanced peoples participation in SCWM
4.5.	BSD	Buffer strip development			PPR	Complete package activity will be implemented. Vegetative measures will be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.	P1O10 Trapped sediment upstream P509: Enhanced peoples participation in SCWM
Be emphasized. Maintenance activities will be continued. Beneficiaries will be involved in maintenance.							
5	**Climate Change Adaptation/Resilience Development**			Component Purpose: To improve climate change resilience especially caused by water scarcity for domestic purpose			
6	**Demonstration**			Component Purpose: To improve awareness in the conservation measures especially on improving land productivity			
7	**Social Mobilization**			**Component Purpose:** To establish self-reliant and well-functioning SCWM related Community Based Organizations (CBOs) and Civil Societies Organizations (CBOs)			
7.1.	Social Mobilization		No. of communities	PPR	Extension / development support to the CBOs and CSOs will be continued CBOS and CSOs will function following Good Governance principles	P404: Established self-reliant and well-functioning SCWM related Community Based Organizations (CBOs) and Civil Societies CSOs) P509: Enhanced peoples' participation in SCWM	
7.2.	Training		No. of Farmers	PPR	Farmers continuously apply learning on conservation practices	P1O3 Increased conservation farming practices. P205: Promoted income generating opportunities. P505: Delivered effective	

					SCWM extension services. P509: Enhanced people's participation in SCWM.

21.3 Budget

Total budget for the implementation plan is estimated as describe below table: 21-4.

Table 21-4: Estimated budget for implementation plan

SN	Action	Implementing Area	Priority	Timeline					Required Resource	Budget Estimate (Rs Lakh)	Coordinating Agency
				075/76	076/77	077/78	078/79	079/80			
1	Irrigational cannel upgrade	Within micro watershed	1	✓	✓				Public Participation	20	Municipality, Irrigation
2	Landslide erosion control	Within micro watershed	3		✓	✓			Public Participation	10	Watershed
3	Pond construction	Within micro watershed	2	✓					Public Participation	10	Watershed
4	Water spring conservation	Within micro watershed	1	✓	✓				Public Participation	30	Watershed, Municipality
5	Foot trail upgrade	Within micro watershed	4	✓					Public Participation	5	watershed, Municipality
6	Khaharekhola control	Within micro watershed	3	✓					Public Participation	15	Watershed, Municipality
7	Classroom construction	Within micro watershed	3				✓	✓	Public Participation	100	Education, Watershed
8	Community house construction	Within micro watershed	3				✓	✓	Public Participation	100	Municipality
9	Public awareness programme	Within micro watershed	1	✓	✓	✓	✓	✓	Public Participation	5	Municipality
10	Afforestation (fruits plantation)	Within micro watershed	1	✓	✓				Public Participation	15	Municipality, Forestry, Watershed
11	Vegetable farming	Within micro watershed	1	✓	✓				Public Participation	5	Agricultural, Municipality
12	Livestock farming (Goat)	Within micro watershed	2		✓				Public Participation	5	Municipality
	Total									320	

22. Implementation, Monitoring, and Evaluation

22.1 Organizational Structure

The Government of Nepal established the Basin Management Centre (BMC) under Department of Forests and Soil Conservation (DFSC) with highlighting to better represent its roles and responsibilities on basin management. The implementation of the micro-watershed management plan is aimed through the existing Organizational Structure of the Basin Management Centre, Koshi, Udayapur. However, depending upon need and resource available implementation can be speed up and accordingly the required man-power need to be managed. Considering the recent state restructuring and revisions in roles and responsibilities, BMC will provide technical inputs in planning, implementation and monitoring of the plan.

22.2 Implementation Mechanism

Implementation of the micro-watershed management plan will be carried out following the principles and norms of the DFSC the then DSCWM. Field implementation of the activities will be carried out with the participation of the community group formed at the local level. With social mobilization by local organizations and technical guidance of the BMC, community group will prepare implementation plan based on existing priorities and resource available and community's contribution will be jointly worked out following the norms, rules, management guidelines and implementation modalities of the government. Scale of implementation will be based on the resource available as well as community's capacity for the implementation. Total conservation measures required will guide for prioritization of activities with the community for implementation. Considering the watershed approach where the catchment area lies within Ward No. 11 of Halesi Tuwachung Municipality. This ward will be vital in implementation of the micro-watershed management plan mainly to avoid duplication, facilitate resource leverage and local resource mobilization. Local level implementation will be largely coordinated with existing natural resource management groups such as community forests user groups and any other similar groups working to maintain ecological integrity and watershed health.

22.3 Monitoring and Evaluation

The monitoring will be at activity, prioritized micro-watershed and micro-watershed level and at inputs, outputs and results levels. The monitoring will be participatory in nature, the participants will include from line agencies, Municipality and Rural Municipality and beneficiaries. It will be done at the site of implementation and at least once for each micro-project. The public audit for completed project will be mandatory to maintain good understanding and trust between coordination committee and beneficiaries.

The line agency representatives, local body and representatives of the micro watershed coordination committee will participate in the monitoring and progress review. The focus of the monitoring and progress review will be functioning of coordination mechanism, constraints in fund flow, and maintaining quality and standard. There will also be annual review with similar participants which focuses on sharing lessons and challenges for further improvement and to recommend priorities for the next year.

Table 22-1: Monitoring plan of Chhange Khola micro-watershed

Level of Monitoring	Why	Who	When	How
Micro-watershed level (Activities Monitoring)	Focus on flow of inputs, compliance of implementation schedule, accountability and ownership building	CFUGs, Other relevant groups	Pre, During and within 1 week of activities implementation.	Public Hearing, Minute, Report, Photographs etc
Micro-watershed level (process and Output level)	Maintain work quality and transparency, track the progress and provided feedback	CFUGs, Local elected representatives from municipality	At least once in each trimester	Field observation, Public Hearing, Minute of meetings, Report, Photographs etc.
District Level (Output and Outcome)	Monitoring the achievement and impact of the program	Municipality, Program/project, DSCO	At least once in year	Joint monitoring, Public Hearing, Minute of meetings, Report, Photographs, Yearly and monitoring reports etc.

References

Branch Statistics Office. 2063/2064. District Profile of Khotang. Branch Statistics Office. Udayapur. Nepal.

CDG/WECS, 1999. Study of Socio-Economic And Environmental Impact of Land Erosion and Landslides Occurring in Nepal's Mid and Far Western Development Regions on The Lower Area Habitat. Central Department of Geography/Water and Energy Commission Secretariat, CDG/WECS, HMG, Nepal, 41 p.

Department of Local Infrastructure Development and Agriculture Roads (DoLIDAR), 2016. Statistics of Local Road Network (SLRN). December 2016. Nepal.

Department of Soil Conservation and Watershed Management. 2015. Soil Conservation and Watershed Management Programs/Activities (Definition, Objective, Scope, and Working Strategy) Version-3. Government of Nepal. Ministry of Forests and Soil Conservation and Watershed Management. Babarmahal, Kathmandu. September, 2015.

Department of Soil Conservation and Watershed Management. 2016. Micro Watershed Management Planning Guideline. Government of Nepal. Ministry of Forests and Soil Conservation and Watershed Management. Kathmandu. June, 2016.

District Soil Conservation Office. 2018. Integrated Micro-Watershed Management Plan of Puntura Micro Watershed, Dadeldhura District, Nepal. Government of Nepal. Ministry of Forests and Soil Conservation and Watershed Management. District Soil Conservation Office. Dadeldhura, Nepal. 2018.

Department of Soil Conservation and Watershed Management. 2012. Watershed Management Plan for Mohana River, Kailali District. Government of Nepal. Ministry of Forests and Soil Conservation and Watershed Management. Babarmahal, Kathmandu. November, 2012.

LRMP, (1985/86). Land Capability Report, Nepal: Land Resources' Mapping Project, Kathmandu.

Ministry of Environment (MoE)2010. Climate Change Vulnerability Mapping for Nepal. Kathmandu, Nepal.

Nepal Gazette. 2017. Ministry of Federal Affair and Local Development Notice, Section 66, Number 58, Part 4. 2073-11-27