STANDARD LETTER OF AGREEMENT BETWEEN THE UNITED NATIONS DEVELOPMENT PROGRAMME AND MOUNTAIN RISK ENGINEERING UNIT- TRINHUVAN UNIVERSITY ON THE IMPLEMENTATION OF LANDSLIDE HAZARD ASSESSMENT IN EARTHQUAKE-AFFECTED DISTRICT WHEN UNDP SERVES AS IMPLEMENTING PARTNER

Your Excellency,

1. Reference is made to the consultations between officials of the **United Nations Development Programme** (hereinafter referred to as "**UNDP**") in Nepal and officials of **Mountain Risk Engineering Unit - Tribhuvan University (MREU- TU)** with respect to the realization of activities by **MREU- TU** in the implementation of the **Landslide Hazard Assessment in Earthquake-Affected Districts** as specified in Attachment 1: Project Proposal, to which UNDP has been selected as implementing partner.

2. In accordance with the Project Proposal and with the following terms and conditions, we confirm our acceptance of the activities to be provided by MREU- TU towards the project, as specified in Attachment 2: Description of Activities (hereinafter referred to as "Activities"). Close consultations will be held between MREU- TU and UNDP on all aspects of the Activities.

3. MREU- TU shall be fully responsible for carrying out; with due diligence and efficiency, all Activities in accordance with its financial regulations, rules and other directives, only to the extent they are consistent with UNDP's Financial Regulations and Rules. In all other cases, UNDP's Financial Regulations and Rules must be followed.

4. In carrying out the activities under this Letter, the personnel and sub-contractors MREU- TU shall not be considered in any respect as being the employees or agents of UNDP. UNDP does not accept any liability for claims arising out of acts or omission of MREU- TU or its personnel, or of its contractors or their personnel, in performing the Activities or any claims for death, bodily injury, disability, damage to property or other hazards that may be suffered by MREU- TU, and its personnel as a result of their work pertaining to the Activities.

5. Any subcontractors, including NGOs under contract with MREU- TU, shall work under the supervision of the designated official of MREU- TU. These subcontractors shall remain accountable to MREU- TU for the manner in which assigned functions are discharged.

6. The total amount of the agreement is **NPR 2,758,350.00 (NPR Twenty seven lakh fifty-eight thousand three hundred fifty).** Upon signature of this Letter, UNDP will make payments to **MREU-TU**, according to the schedule of payments specified in Attachment 3: Schedule of Activities, Facilities and Payments. Following is the bank detail:

Bank's Name: Lumbini Bank Limited

Account Holder's Name: Mountain Risk Engineering Unit, Tribhuvan University, Kiritipur, Kathmandu

Account Type: Current

Account Number: 10100566

7. MREU- TU shall not make any financial commitments or incur any expenses which would exceed the budget for the Activities as set forth in Attachment 3. MREU- TU shall regularly consult with UNDP concerning the status and use of funds and shall promptly advise UNDP any time when MREU- TU is aware that the budget to carry out these Activities is insufficient to fully implement the project in the manner set out in the Attachment 2. UNDP shall have no obligation to provide MREU- TU with any funds or to make any reimbursement for expenses incurred by MREU- TU in excess of the total budget as set forth in Attachment 3.

8. MREU- TU shall submit a cumulative financial report each quarter (31 Dec 2015, 31 Jan, 2016). The report will be submitted to UNDP through the UNDP Country Director or UNDP Resident Representative within 30 days following those dates. The format will follow the standard UNDP expenditure report [a model copy of which is provided as Attachment 4]. UNDP will include the financial report by MREU- TU in the financial report for [Project id 00077652 Comprehensive Disaster Risk Management Programme].

9. MREU- TU shall submit such progress reports relating to the Activities as may reasonably be required by the project manager in the exercise of his or her duties.

10. MREU- TU shall furnish a final report within 12 months after the completion or termination of the Activities, including a list of non-expendable equipment purchased by MREU- TU and all relevant audited or certified financial statements and records related to such Activities, as appropriate, pursuant to its Financial Regulations and Rules.

11. Equipment and supplies that may be furnished by UNDP or procured through UNDP funds will be disposed as agreed, in writing, between UNDP and MREU- TU.

12. Any changes to the Project Document which would affect the work being performed by MREU- TU in accordance with Attachment 2 shall be recommended only after consultation between the parties.

13. For any matters not specifically covered by this Letter, the Parties would ensure that those matters shall be resolved in accordance with the appropriate provisions of the Project Document and any revisions thereof and in accordance with the respective provisions of the Financial Regulations and Rules of the MREU- TU and UNDP.

14. The arrangements described in this Letter will remain in effect until the end of the project, or the completion of activities of MREU- TU according to Attachment 2, or until terminated in writing (with 30 days' notice) by either party. The schedule of payments specified in Attachment 3 remains in effect based on continued performance by MREU- TU unless it receives written indication to the contrary from UNDP.

15. Any balance of funds that is undispersed and uncommitted after the conclusion of the Activities shall be returned within 90 days to UNDP.

16. Any amendment to this Letter shall be effected by mutual agreement, in writing,

17. All further correspondence regarding this Letter, other than signed letters of agreement or amendments thereto should be addressed to [*name and address of Country Director/Resident Representative, UNDP*].

18. MREU- TU shall keep the UNDP Country Director/Resident Representative fully informed of all actions undertaken by them in carrying out this Letter.

19. UNDP may suspend this Agreement, in whole or in part, upon written notice, should circumstances arise which jeopardize successful completion of the Activities.

20. Any dispute between the UNDP and MREU- TU arising out of or relating to this Letter which is not settled by negotiation or other agreed mode of settlement, shall, at the request of either party, be submitted to a Tribunal of three arbitrators. Each party shall appoint one arbitrator, and the two arbitrators so appointed shall appoint a third arbitrator, who shall be the chairperson of the Tribunal. If, within 15 days of the appointment of two arbitrators, the third arbitrator has not been appointed, either party may request the President of the International Court of Justice to appoint the arbitrator referred to. The Tribunal shall determine its own procedures, provided that any two arbitrators shall constitute a quorum for all purposes, and all decisions shall require the agreement of any two arbitrators. The expenses of the Tribunal shall be borne by the parties as assessed by the Tribunal. The arbitral award shall contain a statement of the reasons on which it is based and shall be final and binding on the parties.

21. If you are in agreement with the provisions set forth above, please sign and return to this office two copies of this Letter. Your acceptance shall thereby constitute the basis for MREU- TU participation in the implementation of the project.

Yours sincerely,

Signed on behalf of UNDP

Sophie Kemkhadze
Deputy Country Director (P), UNDP
Date: 10 December 2015

Empowered lives.
Resilient nations.

Signed on behalf of MREU-TU

Professor Dr Megh Raj Dhital
National Co-ordinator, MREU-TU, Kathmandu
Date: December 2015

MOUNTAIN RESEARCH UNIT
1995
TRIBHUVAN UNIVERSITY

Attachment 1

PROJECT DOCUMENT (Attached separately)

Attachment 3

Scheduled of Activities, Facilities and Payments

Year __2015/1016___

EXPECTED CP OUTPUTS and indicators including annual targets	PLANNED ACTIVITIES *List all activities to be undertaken during the year towards stated outputs*	Timeframe 2015				Planned Budget		Schedule of payments by UNDP			
		2015		2016		Budget Description	Amount NRs	2015		2016	
		Q3	Q4	Q1	Q2			Q3	Q4	Q1	Q 2
1) Inventory of earthquake induced landslides and crack zones in the watersheds of the selected district	Identification of landslide types and potential landslide damming sites, description of debris/sediment characteristics and estimation of debris volume areas						**2,758,350**		**1,379,175**		
	Identification of mitigation measures in the short to medium term										

2) Mapping of availability of water sources and their dynamics Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and potentiality of debris transportation in downstream areas with respect to distance from current deposition areas	Determination of the most appropriate methodology for landslide hazard, vulnerability and risk mapping which the Government of Nepal can endorse as a guideline									
3) Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options	Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options								1,379,175	

	Assessment of availability of water sources and their dynamics (drying, shifting /underground movement of water springs)										
						Total	**2,758,350**		**1,379,175**	**1,379,175**	

Payment Schedule

- First installment: NRs **1,379,175.00** (50 % of the total amount of agreement) After Inception Report received
- Final instalment: NRs **1,379,175.00** (50 % of the total amount of agreement) After Final Report received.

Note:

- Expenditures for personnel services may be limited to salary, allowances and other entitlements, including the reimbursement of income taxes due and travel costs on appointment to the project, duty travel within the programme country or region and repatriation costs.
- Adjustments within each of the sections may be made in consultation between UNDP and MREU- TU. Such adjustments may be mace if they are in keeping with the provisions of the Programme Support/Project Document and if they are found to be in the best interest of the project.

Attachment 4

MODEL UNDP EXPENDITURE REPORT

Period ___2015 to Jan 2016____

EXPECTED CP OUTPUTS and indicators including annual targets	PLANNED ACTIVITIES *List all activities to be undertaken during the year towards stated outputs*	Planned Budget		Payments and Expenditures		
		Budget Description	Amount	Payments received	Expenditures	Balance
1) Inventory of earthquake induced landslides and crack zones in the watersheds of the selected district	Identification of landslide types and potential landslide damming sites, description of debris/sediment characteristics and estimation of debris volume areas					
	Identification of mitigation measures in the short to medium term					
2) Mapping of availability of water sources and their dynamics Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and	Determination of the most appropriate methodology for landslide hazard, vulnerability and risk mapping which the Government of Nepal can endorse as a guideline					

potentiality of debris transportation in downstream areas with respect to distance from current deposition areas						
3) Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options	Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options					
	Assessment of availability of water sources and their dynamics (drying, shifting /underground movement of water springs)					
		Total				

SUBMITTED TO:
UNDP, Lalitpur, Nepal

PROPOSAL

for

Landslide Hazard Assessment in Earthquake-Affected Districts

SUBMITTED BY:
Mountain Risk Engineering Unit
Tribhuvan University
Kirtipur, Kathmandu
Nepal

9 December 2015

Proposal

for

Landslide hazard assessment in earthquake-affected districts

Background

The 7.8 magnitude Gorkha Earthquake of 25 April 2015 followed by more than 300 aftershocks greater than 4.0 magnitudes caused more than eight thousands deaths and 22,300 injuries. Out of seventy-five districts, fourteen were severely affected, while other 17 districts were moderately affected by the earthquake. The Post-Disaster Need Assessment study carried out after the earthquake by several institutions has also identified Dolakha, Sindhupalchowk, Gorkha, Nuwakot, Rasuwa, and Dhading as severely disaster impacted districts.

The destruction was widespread covering many residential and governmental buildings, heritage sites, schools and community buildings as well as rural roads, bridges, water-supply systems, agricultural land, trekking routes, hydropower plants and sports facilities. Several rural areas in central and western parts of Nepal were devastated due to the earthquakes. The main shock and subsequent aftershocks have damaged the infrastructures by triggering landslides, initiating several cracks on the land surface, drying some and rejuvenating other springs and water sources, and also by diverting the original groundwater and surface water flows. These circumstances have created more secondary impacts of slope instabilities and extended landslides zones leading to the increase in potential landslide hazard zones after the summer monsoon.

Study Areas

Out of severely impacted districts by Gorkha earthquake of 2015, Gorkha, Dhading, and Rasuwa are selected for the landslide hazard assessment. The unit of study will be the watersheds and sub-watersheds within the 3 districts.

Objectives

There is a strong need to understand nature of landslides triggered by the Gorkha earthquake and its aftershocks in connection with recent monsoonal rain after the earthquake for proper planning in the areas by governmental agencies, private organisations and civil societies. Government departments, such as the Department of Soil Conservation and Watershed Management (DSCWM), under the Ministry of Forests and Soil Conservation (MoFSC) and the Department of Water Induced Disaster Prevention (DWIDP), under the Ministry of Irrigation (MoI) are particularly giving emphases on such landslide assessment and data collection for the implementation of short-term and long-term mitigation measures in the landslide-affected areas towards increasing landslide hazard resilience of watersheds. Therefore, this investigation will support the urgent need of both of the aforementioned governmental departments by collecting data and information gathering on landslides in order to

future planning of their activities. The prime objective of the assessment is to have a comprehensive understanding of the nature, type and distribution of landslides and cracks in the watersheds of study districts. The assessment will also identify and recommends mitigation measures to minimize the risks of landslides and reduce their future impacts.

Scope of the study

The proposed study has the following scopes.

I. Identification of landslide types and potential landslide damming sites, description of debris/sediment characteristics and estimation of debris volume areas

1. Identification of the potential landslide-damming sites of the rivers in the study area
2. Assessment of the contribution of the sediment in river system leading to landslide damming
3. Assessment of flood hazard to the downstream region, if there is a possibility of landslide dam outburst flood (LDOF) in the river section

II. Identification of mitigation measures in the short to medium term

1. Classification of the landslides identified in Part I above, into the following categories.
    a. Mitigable mass movements (comparatively shallow, small- to medium-sized, with threat to life and property, economically justifiable to be controlled)
        i. With low cost techniques (crack sealing, drainage management, toe protection, bio-engineering techniques, and the like)
        ii. With high-cost techniques (high-cost civil engineering structures)
    b. Non-mitigable mass movements (large-scale, deep-seated, actively expanding slides and falls)
2. Classification of landslides into those affecting (or not affecting) buildings, agriculture land, road, irrigation canal at the current stage and their potential impact in the near future
    - Landslide associated with infrastructure (irrigation, road, trail, drinking water source, unmanaged drainage, such as drains from a village)
    - Distinction between the landslides damaging the infrastructure or infrastructures causing landslides (unmanaged drainage, toe cutting)
    - Qualitative assessment of the economics of landslide treatment against the realignment of the infrastructures

III. Determination of the most appropriate methodology for landslide hazard, vulnerability and risk mapping which the Government of Nepal can endorse as a guideline

1. Organisation of a half-day consultative meeting for co-ordination and discussion on available methodology of landslide hazard and vulnerability assessment in Nepal

2. Proposing a most appropriate methodology for landslide hazard, vulnerability, and risk mapping in the investigated three districts as well as contributing towards the formulation of a guideline for future use by the Government of Nepal

IV. Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options

1. Landslide hazard, vulnerability and risk mapping using the proven, most appropriate methodology developed above
2. Illustration of the settlements/houses, schools, and other infrastructures, cultivated land, and damaging potentialities of the potential landslides

V. Assessment of availability of water sources and their dynamics (drying, shifting /underground movement of water springs)

1. Review of spring and stream water source availability in the watershed of landslide-affected areas
2. Assessment of the dynamics of water sources in the earthquake-affected areas of the watershed
3. Analysis of the changes in hydrogeology in the watershed

Methodology

The assessment will follow a standard science based methodology using both qualitative and quantitative analysis techniques. The study team will develop a methodology for the assessment based on the objectives and scope of work as mentioned above. In general the methodology, will include, Google Earth maps and other digital platforms, with strong anchorage of local knowledge and practices, and review of similar contemporary studies being conducted by academic and research institutions and the government after 25 April 2015. Recommendations for the prioritized/high ranked watershed/landslide specific mitigation measures should be presented in a clear manner indicating different land use practices, private and community infrastructures showing different hazard zones

This task will be carried out by Mountain Risk Engineering (MRE) Unit of Tribhuvan University, which has recently signed the MoU with DSCWM. The MRE Unit of Tribhuvan University will be supported by respective DISCO office assigned persons during the field work of the targeted districts and the persons assigned by the DSCWM will take the responsibility of supervision of all MRE technical team and the draft report will be reviewed by team comprising personals from the DSCWM and UNDP. The MRE Unit will mobilize a group of experts (as given below) to carry out the assessment and finalize the assessment report. The final report will be prepared after the review and supervision of the draft reports by the concerned team of DSCWM team members including other experts.

Output and deliverables

A comprehensive report giving details of approach taken and outcomes of all the tasks described in the scope of the work has to be produced. The report needs to be fully referenced (with data sources identified). The final report should be submitted in hard and soft copies. All maps should be produced in GIS software. The assessment report contains the following information;

- Inventory of earthquake induced landslides and crack zones in the watersheds of the selected district
- Mapping of availability of water sources and their dynamics Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and potentiality of debris transportation in downstream areas with respect to distance from current deposition areas
- Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options

Time Frame

The tentative duration of the task will be of 1 month from the starting from the date of agreement (Table 1). One inception meeting /workshop will organized in the beginning of the assessment. The draft report will be presented to the wider stakeholders for final consultation before finalization. A dissemination workshop will be organized at the end of the study. The detailed timeframe will be further defined in the inception workshop.

Table 1: Approximate Timeframe for Assessment

Activities	**Duration**	Deadline	**Responsibilities/Review**
Inception Meeting/ workshop (Presentation of Action plan with tools and methodology)	Half Day	30 November 2015	DSCWM, TU and UNDP
Desk Review and Collection/finalisation of the tools/methodology etc	2 Days	2 December 2015	Study Team/TU
Fieldwork	15 Days	18 December 2015	Study Team/TU (3 districts)
Analysis/Desk work	8 Days	26 December 2015	Study Team/TU
Draft Report Submission	4 Days	30 December 2015	Study Team/TU
Review of the Draft Report	1 Week	04 January 2016	Review Team
Final Report Submission		10 January 2016	Study Team/TU
Dissemination of Results		10 January 2016	DSCWM, TU and UNDP

Team Composition

The core assessment team will be led by a Team Leader and include the following other members (Table 2): watershed management expert/Senior geologist (1), engineering Geologist (1), hydro-geologist/hydrologist (1), GIS Expert (1). In addition, assistant geologists and/or research assistants (6) will be needed to help the assessment team in the field and during the desk study.

Table 2: Composition of the study team

Position	Qualification/ Experience	No of Days	Activities
Team Leader/ Watershed management Expert or Senior Geologist	Master's degree in relevant subject with at least 20 years of relevant experience	30 days	Coordination with the study team (both the Government of Nepal and others), communication and collaborate with DSCWM and UNDP, management of logistic and management related issues throughout the process; design of overall study framework and methodology; guiding relevant experts to carryout tasks described under scope of the study, organising and supervising the field survey, compilation and finalisation of the reports in coordination with the team members and submit the report as stipulated time frame Team leader will oversee the study and make sure that all the components of study have been linked and well reflected.
Engineering Geologist	Preferably Ph D with at least 10 Years of experiences in the relevant areas or Masters Degree in relevant subject with at least 20 years of experience in Engineering Geology	30 days	Leading all technical tasks described under scope of the study (I to V). Undertaking detailed geological study to identifying the potential landslides in landslide hazard mapping format with ranking; identifying crack zones; assisting the Team Leader to compile and finalise the report
Hydro-geologist/hydrologist	Preferably Ph D with at least 10 Years of experiences in the relevant areas or Masters Degree in relevant subject with at least 20 years of experience in Hydro-Geology/hydrology	30 Days	Identifying the hydrological dimension in the post-earthquake context such as drying of springs, shifting of springs, impacts in tributaries and its course; undertaking detailed hydrogeological study of the study districts to identify linkage between landslides and springs; supporting to identify possible damming of streams/rivers of the study districts; assisting the Team Leader to compile and finalise the report

GIS Expert	At least Masters Degree in GIS/RS with 10 Years of relevant experience	30 days	Analysing the information related to the geological and geomorphic aspects, hazard assessment and analysis; preparation of the different hazards maps using satellite imagery and GIS analysis; assisting the Team Leader to compile and finalise the report
Assistant Geologist/research assistants (6)	Masters Degrees in Geology and relevant field with at least 1 Year of relevant experience	30 days	Collecting field data on landslides, cracked areas and water sources/springs, carrying out ground truthing of selected landslides, compiling field data and assisting to prepare draft report

Timeline for submission of derivables

The proposed timeline for the derivable will be the following.

1. Inception Report: By the end of December 2015
2. Draft Report: By 15 January 2016
3. Final Report: By the end of January 2016

Budget

The cost dissemination (Table 3) of this task can be classified in the following categories.

Table 3: Budget estimate

Categories	Team combination	Man days	Rate, Rs	Subtotal, Rs
1. Human resources	Team leader/Geologist or watershed expert (1)	30	10000	300,000.00
	Geologist/Hydrogeologist (1)	30	8000	240,000.00
	Engineering geologist (1)	30	8000	240,000.00
	GIS expert (1)	30	6000	180,000.00
	Assistant geologists (6)	180	2700	486,000.00
	Administration and accounting (1)	10	2000	20,000.00
2. Field expenses	Transpiration during field survey and verification in three districts	54	15000	810,000.00
	DSA during field survey	54	1000	54,000.00
2. Administration/accounting	Secretarial services (printing, drawing, photocopy, binding, etc)	lump sum	60000	60,000.00
3. Field co-ordination, review and supervision for the task team	Field co-ordination by respective District Soil Conservation Office	15 x 3 = 45 days	2000	90,000.00
	Overall supervision of the team and review of the draft reports	7	21000	147,000.00
4. Other costs	Official overhead		5% of above	131,350.00
	Grand total, Rs			**2,758,350.00**

Terms of Reference

Gorkha Earthquake induced landslides/instabilities identification and hazard assessment in all watersheds of the affected districts

Undertaking is identification and assessment of earthquake-induced landslides/instabilities, their impacts on the watersheds, and hazard assessment in the selected affected districts to help develop recovery and mitigation plan for short, medium, and long term

Study Coverage Districts: Gorkha, Dhading and Rasua

Background

A 7.8 magnitude of Gorkha earthquake (25 April 2015)followed by more than 300 aftershocks greater than magnitude 4.0 (as of 7 June 2015) brought disaster with over 8,790 casualties, 22,300 injuries, and almost one-third of the population of Nepal impacted. Thirty-one of the country's 75 districts have been affected, out of which impacts was quite serious in 14 districts. Recent PDNA study has identified six lowest-HDI districts namely Dolakha, Sindhupalchowk, Gorkha, Nuwakot, Rasuwa, and Dhading as severely disaster impacted.

The destruction was widespread covering residential and government buildings, heritage sites, schools and health posts, rural roads, bridges, water supply systems, agricultural land, trekking routes, hydropower plants and sports facilities. Rural areas in the central and western regions were particularly devastated and further isolated due to road/trail damage and obstructions. The strong tremors and continuous aftershocks have resulted the secondary impacts such as landslides, cracking of the land surface, drying of some water sources, shifting of the springs, changes in the ground water hydrology and water quality. Due to the weakened, cracked, and destabilised slopes and surfaces, the vulnerable areas have now become even more susceptible to landslides after the monsoon.

The ToR defines the scope and objectives of the assessment and highlights on expected deliverables and expertise required to conduct the assessment.

Study Areas

Three out of seven hard-hit districts namely Gorkha, Dhading, and Rasua have been selected for the assessment. The unit of study will be the watersheds and sub-watersheds within the 3 districts.

Objective of the Assessment

Department of Soil Conservation and Watershed Management (DSCWM) of Ministry of Forests and Soil Conservation (MoFSC) urgently requires data and information about the locations,

dimensions and impacts of earthquake induced landslides on the watersheds to help it implement mitigation measures in the short term. It further plans to use the information to improve the watershed management plans in the medium and long term to make the watersheds resilient to future secondary hazards. Likewise the Department of Water Induced Disaster Prevention (DWIDP) of Ministry of Irrigation (MoI) is keen about understanding the risks of deep seated landslides induced by the earthquake and design possible mitigation options. The assessment will support DSCWM's and DWIDP's current urgencies to design and implement mitigation options and support medium to long term planning priorities.

The objective of the assessment is to have a comprehensive understanding of the locations, dimensions and impacts of the earthquake-induced landslides and cracks on the physiographic, geomorphic, hydrological, and socio-economic aspects of the watersheds. The assessment will also identify short- to medium-term mitigation measures to minimise the risks of landslides and reduce the impacts on water sources.

Scope of the Study

The scope of the study will include:

I. Mapping of earthquake induced landslides and cracked areas in the watersheds/sub-watersheds of the selected districts
II. Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and potentiality of debris transportation in downstream areas with respect to distance from current deposition areas
III. Identification of mitigation measures in the short to medium term
IV. Landslide mapping with appropriate ranking and treatment options
V. Assessment of availability of water sources and their dynamics (drying, shifting /underground movement of water springs)

Details about the scope of the assessment are given below:

I. Mapping of earthquake induced landslides and cracked areas in watersheds/sub-watersheds of selected district

1. Prepare detailed landslide inventory for both shallow and deep seated landslides (dimension, types of debris, elements affected etc.)
2. Prepare the landslide cracked area and gully distribution map and establish the linkages with various terrain parameters
3. Overlay with settlements, community infrastructures for interrelationship analysis
4. Categorise the landslides through ground verification of landslide data obtained from the imagery analysis

5. Categorise both shallow and deep seated landslides (landslides that need to be stabilised/treated as soon as possible using low cost technology, landslides that require treatment but high cost engineering structures need to be constructed, and landslide that will be stabilised by nature after some years- require no treatment)

II. Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and potentiality of debris transportation in downstream areas with respect to distance from current deposition areas

1. Identify the potential landslide damming sections of the rivers in the watersheds
2. Assess the contribution of the sediment in river system leading to landslide damming
3. Prepare the flood hazard/inundation map of the downstream if the Landslide Dam Outburst Flood (LDOF) occurs in the river section illustrating its potential damaging influences

III. Identification of mitigation measures in the short to medium term

1. Distinguish between the treatable and non-treatable (Geological failure) landslides
   - Treatable (comparatively shallow, small to medium size, threat to life and property, Economically justifiable)
   i. With low cost techniques (Crack sealing, drainage management, tow protection, bio-engineering techniques, etc)
   - With high cost techniques (High cost Engineering structures
   - Geological landslide (large scale, deep seated)
2. Identify the landslide not affecting infrastructures such as village, agriculture land, road, irrigation (no action required)
3. Landslide associated with infrastructure (Irrigation, Road, Trail, Drinking water source, unmanaged drainage such as from village)
4. Distinguish between the landslides damaging the infrastructure or infrastructures causing landslides (unmanaged drainage, tow cutting)
5. Carryout the Qualitative assessment of the Economics of landslide treatment against the realignment of the infrastructures

IV. Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options

1) Carry out landslide hazard, vulnerability and risk mappingusing the proven, most appropriate methodology

2) Illustrate the settlements/houses, schools, other infrastructure, cultivation land damaging potentialities of the potential landslides

V. Assessment of availability of water sources and their dynamics (drying, shifting /underground movement of water springs)

- Assess the status of spring and stream water source availability in the watershed
- Identify the status of exiting water sources with respect to water availability
- Assess the changes in Hydro-geology in the watershed

Methodology

The assessment will follow a standard science based methodology using both qualitative and quantitative analysis techniques agreed by the Steering Committee led by the DSCWM. The study team is supposed to develop the methodology for the assessment based on the objectives and scope of work and propose to Steering Committee for approval. In general the methodology will include GIS based spatial analysis of high resolution Remote Sensing Data such as satellite imagery of pre and post-earthquake scenario, Google Earth maps and other digital platforms, with strong anchorage of local knowledge and practices, and review of similar contemporary studies being conducted by academic and research institutions and the government after 25 April 2015. Recommendations for the prioritised/high ranked watershed/landslide specific mitigation measures should be presented in a clear manner using tables, GIS maps following the scope of the work such as:

- existing land use practices (forest cover, agricultural practices, settlement, open areas, river bank etc)
- community infrastructures/ resources
- landslide, hazards map with Very high, high and low severity showing the most vulnerable communities with number of households

In the spirit of the MoU signed between DSCWM and Mountain Risk Engineering Unit of Tribhuwan University, the study will be carried out by the Mountain Risk Engineering Unit of Tribhuvan University under the guidance of the Steering Committee led by DSCWM (composition of the Steering Committee is given below). The Mountain Risk Engineering Unit will mobilise a group of experts (as given below) to carry out the assessment and finalise the assessment report following a review carried out by the expert/s designated by the Steering Committee. The DSCWM and DWIDP will each designate an expert to be the part of the study team and provide necessary inputs and expertise to the study. ICIMOD will support the study by providing available information, data, maps and other knowledge products and produce new datasets, maps and reports as required.

The overall assessment process will be guided by the following principles:

- Application of proven and updated tools and methodology using high resolution latest imagery with strong field verification
- Reference to other analysis remotely done by national and international research and academic institutions and government led assessments
- Distinction between earthquake induced and potential landslides (that may be triggered by rainfall) and their secondary impacts
- Integration of local knowledge/ perception
- Priorities to build community resilience to the landslides
- Engagement with academia, researchers, stakeholders and all related GoN Departments

Output and deliverables

A comprehensive report giving details of approach taken and outcomes of all the tasks described in the scope of the work has to be produced. The report needs to be fully referenced (with data sources identified). The final report should be submitted in electronic copies in CD and hard copies. All GIS maps should be produced in ARC GIS software and need to be submitted both hard copy and electronic copies in CD with full sets of linked data source files. The following must be included with final report;

- Mapping/Inventory of earthquake induced landslides and crack zones in the watersheds of the selected district
- Mapping of availability of water sources and their dynamics (drying, shifting /underground movement of water sources/springs)
- Identification of landslide types, potential landslide damming sites, description of debris/sediment characteristics, estimation of debris volume and potentiality of debris transportation in downstream areas with respect to distance from current deposition areas
- Landslide hazard, vulnerability and risk mapping with appropriate ranking and treatment options

Time Frame

The tentative duration of the task will be maximum of 1 month. One inception meeting /workshop will organised in the beginning of the assessment. The draft report will be presented to the wider stakeholders for final consultation before finalisation. A dissemination workshop will be organised at the end of the study. The detailed timeframe will be further defined in the inception workshop.

Table 1: Approximate Timeframe for Assessment

Activities	**Duration**	Deadline	**Responsibilities/Review**

Inception Meeting/ workshop (Presentation of Action plan with tools and methodology)	Half Day	30 November 2015	DSCWM, TU and UNDP
Desk Review and Collection/finalisation of the tools/methodology etc	2 Days	2 December 2015	Study Team/TU
Fieldwork	15 Days	18 December 2015	Study Team/TU (3 districts)
Analysis/Desk work	8 Days	26 December 2015	Study Team/TU
Draft Report Submission	4 Days	30 December 2015	Study Team/TU
Review of the Draft Report	1 Week	04 January 2016	Review Team
Final Report Submission		10 January 2016	Study Team/TU
Dissemination of Results		10 January 2016	DSCWM, TU and UNDP

Monitoring and Reporting:

The DSCWM and UNDP will each designate a senior official to guide the study team, monitoring the progress and report to the Steering Committee. The respective DSCOs will be responsible for providing facilitation and coordination support to the study team and report to DSCWM about the progress. The study team will report (fort-nightly progress report sharing and monthly review and reflection meetings) to the Steering Committee through designated officials of the DSCWM and UNDP.

Study Steering Committee:

A Steering Committee, chaired by the Director General of DSCWM of MoFSC, will provide overall guidance and direction for the study. The other members of the study team will include representatives Department of Hydrology and Meteorology, Department of Water Induced Disaster Prevention, ICIMOD and UNDP.

The members of the Steering Committee are further expected to facilitate accessing necessary data and information available in their respective organizations by the study team. The designated focal point from DSCWM will coordinate between the study team and the Steering Committee and act as member secretary for the Steering Committee.

Assessment Team:

The core assessment team will be led by a **Team Leader** and include: watershed management expert/ geologist (1), engineering Geologist (1), hydro-geologist/hydrologist (1), GIS Expert (1). In addition, a number of assistant geologists and/or research assistants (6) will be needed to help the assessment team in the field and during the desk study.

Composition of the assessment team

Position	**Qualification / Experience**	**No of Days**	**Tasks (Tentative, and will be defined by the team leader to address the ToR)**
Team Leader/ Watershed management Expert or Geologist	Master's degree in relevant subject with at least 20 years of relevant experience	30 days	Coordinate with the study team (both GoN and others) , communicate and collaborate with DSCWM and UNDP, manage logistic and management related issues throughout the process; Design overall study framework and methodology; Guide relevant experts to carryout tasks described under scope of the study, Organise and supervise the field survey, compile and finalise the reports in coordination with the team members and submit the report as stipulated time frame Team leader will oversee the study and make sure that all the components of study have been linked and well reflected.
Engineering Geologist	Preferably Ph D with at least 10 Years of experiences in the relevant areas or Masters Degree in relevant subject with at least 20 years of experience in Engineering Geology	30 days	Lead all technical tasks described under scope of the study (I to V). Undertake detail geological study to identify the potential landslides in landslide hazard mapping format with ranking Identify crack zones Assist Team Leader to compile and finalise the report
Hydro-geologist/hydrologist	Preferably Ph D with at least 10 Years of experiences in the relevant areas or Masters Degree in relevant subject with at least 20 years of	30 Days	Identify the hydrological dimension in the post-earthquake context such as drying of springs, shifting of springs, impacts in tributaries and it's course

	experience in Hydro-Geology/hydrology		Undertake detail hydro-geological study of the study districts to identify linkage between landslides and springs. Support to identify possible damming of streams/rivers of the study districts. Assist Team Leader to compile and finalise the report
GIS Expert	At least Masters Degree in GIS/RS with 10 Years of relevant experience	25 days	Analyse the information related to the geological and geomorphic aspect, hazard assessment and analysis, Prepare the different hazards map using satellite imagery and GIS analysis Assist Team Leader to compile and finalise the report
Assistant Geologist/research assistants (6)	Masters Degrees in Geology and relevant field with at least 1 Year of relevant experience	30 days	Collect field data on landslides, cracked areas and water sources/springs, carryout ground truthing of sample landslides, Compile field data and assist to prepare draft report