

**Consultancy
for
The development of Glacier and
Glacial lake Inventory of Northern
Pakistan
for
GLOF-II project**

**Terms of Reference (TOR) for
Consultant firms**

Terms of Reference (TOR)

Project Title

Glacier and Glacial/ Paraglacial Lake inventory delineation under GLOF-II Project.

A. Project Description

The Government of Pakistan has recognized the threat from GLOFs in its National Climate Change Policy and its national determined contribution to monitor changes in glacier volumes and related GLOFs. The northern part of Pakistan consists of world's highest mountains and largest reserves of snow and glaciers outside polar region. Thus, the ecosystem and agriculture system of downstream areas are highly dependent on the melt water from these snow and ice reserves of the country. The presence of glaciers is complemented with the presence of glacial and Para-glacial lakes in the region. These lakes are formed due to climatic and geomorphologic changes i.e. fast retreat of glacier due to increasing warming trends of glacier environment, blockage of river channels as a result of landslide or glacier surge, and debris flows, frequent glacier fluctuations etc. These lakes can release water by sudden outburst and create flood situation in the downstream areas. The magnitude of flood depends on different lake attributes for example its location and glacier situations. Apart from these GLOF events from these lakes, sometime glacier outburst also creates flooding situation in the downstream areas that might be more treacherous since this flood can occurred even during clear sky days. Moreover, the identification of trigger mechanism in glacier outburst flood is complicated if meagre or no information is available with the local people. To

be able to strengthen capacities of vulnerable communities to address the GLOF issue urgently in the scale that is needed, A project titled “Scaling-Up of GLOF Risk Reduction in Northern Pakistan” has been initiated by the Government of Pakistan with the financial assistance from UNDP. The project aimed for the establishment of Early Warning System (EWS) and develop adaptation strategies in the GLOF prone areas. The delineation of glacier and glacial lake inventory is a prime requirement to identify and update the number, size, locations and other relevant characteristics of glaciers, glacial and para-glacial lakes in Pakistan from which are responsible for GLOF/Flash Flood events.

B. Objectives of the Consultancy

The main objective of the consultancy assignment is to update the previous glacier and lakes inventories developed by PMD. The specific aims of this study are:

1. To generate a recent glacier and lakes inventory for the whole mountain range of Pakistan, and to provide information on the general glacier characteristics
2. To evaluate the data accuracy based on the topographic maps using declassified imagery
3. To analyze glacier changes from previous inventories and glacier variability in detail for a subset of glaciers and to identify possible climatic drivers for glacier changes.

C. Scope of Work

1. Review and update the Glaciers and Glacial/ Paraglacial Lake Inventory of Catchments in Northern Pakistan:

Glaciers of Pakistan are the source of water supply to down country in summer season. Glacier melt from mountains in Northern Pakistan is utilized for hydropower generation, drinking water, and it is the source of irrigation to one of the world's largest irrigation system. With recent Global Warming and resultant Climate Change, some of the glaciers of Hindu Kush, Karakoram, and Himalayan mountains (HKH) centered in Northern Pakistan are retreating, whereas others are either stable or surging. Sometimes these glaciers are accompanied by glacial lakes that may outburst and destroy nearby and downstream settlements and civil structures. Therefore, there is a need to review available Glacier and Glacial/ Paraglacial Lake inventory and update it using state of the art digital resources (satellite images) using Geographical Information System Framework. It will provide the basis of the GLOF-II project to identify the potential Glacier Lake Outburst Flooding (GLOF) hotspots, where GLOF-II may strengthen capacities of vulnerable communities to address the GLOF risk.

2. Identification of Surging, Retreating and Stable Glaciers:

Since the global warming and climate change is affecting HKH glaciers differently from rest of the glaciers around the world. Therefore, there is need to review available glacier inventories and to update state of the perennially frozen ice reserves in Northern Pakistan in a new inventory. This new inventory will classify the retreating, stable and surging glaciers and associated GLOF risk. So that the GLOF-II project may strengthening the vulnerable communities against GLOF risks.

3. Development of Digital Glacier and Glacial/ Paraglacial Lake Inventory in GIS Framework:

A Glacier and Glacial/ Paraglacial Lake Inventory in GIS framework will give access to disaster managers, scientists, and end users to manage, retrieve, capture analyze, display and store spatial data. It will provide a decision-making facility to government and services department, moreover updated glacier inventory will help to improve the resource allocation for planning and management of natural resources. Additionally, it will help to evaluate the vulnerability of glaciers toward climate change in different catchments of HKH.

4. Publication of Glacier and Glacial/ Paraglacial Lakes Inventory in peer reviewed research journal:

Since the Glacier and Glacial/ Paraglacial Lake inventory of HKH mountain ranges in northern Pakistan is an important contribution in available glacier data repository and baseline data for future action plans, therefore, it requires to be published in a peer reviewed research journal, soon after the completion of the inventory. This publication will detail methodology and criteria for assessment of Glaciers and Glacial/ Paraglacial Lakes as well.

5. Provision of guidelines for the resource allocation under GLOF-II Project:

The proposed inventory will classify risk factor for different areas, so that GLOF-II project may allocate resources for the amelioration of risk for targeted communities.

6. Standardization of the Glacier and Glacial/ Paraglacial Lake Inventory:

Since the Glacier and Glacial/ Paraglacial Lake Inventory are expected to be compared with other global and regional glacier inventories, therefore, the information contained in the inventory must be comparable with other available inventories.

7. Glacier Lake Hazard and Flood Inundation Modelling:

In case of GLOF event(s) in a mountainous region many structures of socioeconomic importance are affected by it. Such structures may include bridges, national highways and roads network, hydropower plants, schools, religious centers, along with orchards and crop fields that beef up local food security. Therefore, there is a need to map all vulnerable and potential areas in case of GLOF event(s) of different magnitude. This inventory will be accompanied by hazard mapping available in GIS environment.

8. Land Cover/ Land Use of study area:

This inventory will also be accompanied by detailed land use/ land cover of the study area in Gilgit-Baltistan and Khyber Pakhtunkhwa, based on latest high-resolution satellite-based imagery.

9. Future GLOF Hazard Locations:

This inventory will provide Methodology and Criteria for assessment of future GLOF hazards development, as well.

Under the supervision of the Focal Person GLOF-II, Pakistan Meteorological Department and members of supervisory committee and Field Officers, the consultant will perform the following **tasks** but not limited to:

- Develop a standard glacier and glacial/Paraglacial lake inventory of catchments in Hindu Kush, Karakoram, and Himalayas centered in Northern Pakistan (Gilgit-Baltistan, Khyber Pakhtunkhwa and Azad Jammu and Kashmir).
- State of the art, high resolution satellite imagery and digital topographic information must be utilized for the development of the inventory.
- Glacier and Glacial/ ParaglacialLake Inventory shall be developed and supplied in GIS framework for open accessibility and transparency.
- Time Series Analysis of all Glaciers/Glaciers Lakes of GLOF-II program sites (HKH) at least spanning of 30 years for comparison in glacier spread, surges, retreat and changes on account of area, volume & impacts related with GLOF.
- Comparative study of Government Structures in dealing hydro-met, GLOF activities & events in mountainous regions especially HKKH regional countries. The basis can be made from the example of the Department of Hydro-Met in Bhutan, where in our case, mostly departments are working without strong bindings among the relevant departments and usually have solo flights.
- A detailed report on the state of glaciers and glacial/ paraglaciallakes will be provided.
- The report will include detailed methodology and criteria for assessment of Glaciers and Glacial/ Paraglacial Lakes, their risk prioritization.
- Glaciers and glacial/ paraglaciallakes with high, moderate and low risk will be identified so that GLOF-II project may prioritize its resource allocation.
- Consultants may consult PMD experts for the tasks if required.

- For the above tasks the consultant will adopt but not limit to the following approach;
 - Collection and review of all secondary information and documentation;
 - Conduct field visits to the project sites, hold consultations with all relevant stakeholders for the development of Glaciers and Glacial/Paraglacial Lake Inventory.
- Develop and present reports on the topics.

D. Expected Outputs and Deliverables

The selected contractor/service provider will be responsible for the delivery and technical quality of the final products as listed in below Table.

S/N	Deliverables	Timeline	Payment Schedule
1	Submission of Inception Report to include below: <ul style="list-style-type: none"> • Methodology for the assessment prepared and agreed with PMD/UNDP • Terms of Reference for experts prepared and agreed with PMD/UNDP • Draft work-plan for conducting the assessment prepared and agreed with UNDP 	After 2 weeks of contract signed	25%
2	Recruitment of 3 experts (One PhD as team leader and two members with at least master degree in relevant field) for updating the glacier inventory of Pakistan recruited by PMD	After 2 week of approval of inception report	50%
3	<ul style="list-style-type: none"> • Physical and remote data collection by visiting and use of advance remote monitoring technology 	Within 120 days after approval of	

	<ul style="list-style-type: none"> • Compilation and submission of mid-term report 	inception report	
4	A draft Report that includes all items specified recommendations under given tasks Study conducted, and report finalized, presented to Project Steering Committee	Within 180 days after signing of contract	25%
Total			100%

E. Institutional Arrangement

With the overall guidance of the National Project Director, the consultant will be reporting to National Project Manager, GLOF II as and when required. The consultant will work in close collaboration with the National Technical Expert, International Technical Advisor and Provincial Project coordinators in addition to technical experts in PMD.

F. Duration of the Work

Duration of the assignment is **6 months** after signing of contract.

G. Duty Station

Islamabad with field visits to GB and KPK

H. Qualifications of the Successful Individual Contractor

The consulting firm/service provider will provide one full time expert as team lead and two experts as team members. The firm should have prior experience of executing similar work related to glacier inventories, meteorology and possess excellent technical capacity to ensure timely and high-quality deliverables. The consultant should have experience and the ability to work with a wide variety of stakeholders from government agencies, private

companies, NGOs, and research institutions is essential. Only firms/services providers registered with the government regulatory bodies shall be considered. The Services are to be provided by the firm with strong consulting team should meet the following pre-requisites:

1. Team leader should have PhD in Geography/ Glaciology/ Hydrology/ Hydrometeorology, Meteorology/ Natural Resource Management/ Disaster Management/ Environmental Management/ Remote Sensing and GIS// any Climate Change/ Disaster management related discipline and Public Policy with at least ten years of experience of similar types of work or any equivalent/applicable combination of training and experience.
2. Team members should have Master degree in relevant discipline with at least three to five year experience in similar work.
3. Technical expertise and experience in undertaking research, technical studies and glacier assessment and Climate Change and Glacial Lakes Outburst Floods and other climate change related disasters.
4. Must have peer reviewed in international journal having well impact factor.
5. Ability and availability to visit project sites
6. Experience in Geographic Information Systems (GIS).
7. Strong oral and written communication and facilitation skills.
8. Excellent analytical, presentation and report writing skills interpersonal;
9. Knowledge of the project areas (Northern Pakistan) will be an asset
10. Excellent skills in producing high quality reports

I. Qualification Criteria

The application will be assessed and qualify based on technical proposal who secure 70% of the marks outline in the qualification criteria to the next stage of combining with financial proposal. Those firms' do not secure minimum 70% marks in technical proposal will be excluded from further process.

1. Consultant firm's Experience (Experience in implementing similar projects)	30
1.1. Experience in preparing Glacier Inventories, early warning system for GLOF in highland areas Requirement: <ul style="list-style-type: none"> • project references, preferably in developing countries glacier inventories and early warning system for GLOF in highland areas contexts including • Undertaken and Analysis of the glacier inventories and other similar nature of work • Assessment of early warning system in GLOF highland areas 	15
1.2. Experience in preparing high quality Assessment Reports, Feasibility Studies, Research reports for the GLOF and early warning system in Pakistan and the region Requirement: <ul style="list-style-type: none"> • Two report or publication references, preferably one in the South-Asian region 	10
1.3. Experience with working-conditions in Pakistan and/or other countries in the region <ul style="list-style-type: none"> • Good understanding of Climate Change and Glacial Lakes Outburst Floods and other climate change related disasters; • Excellent analytical, presentation and report writing skills; • Excellent interpersonal and computer skills; • Knowledge of the project areas (Northern Pakistan). 	5
2. Applicant's Capabilities	40
2.1 Qualitative assessment of the consultant firm's available Expertise The quality of the expertise appropriate for the project team profiles and personnel appropriate required in the TORs. This sub-criterion is evaluated on the basis of the list submitted by the applicant in accordance with the consultancy requirements. Team have peer reviewed in international journal having well impact factor.	15

Minimum Master’s Degree in natural resource management, disaster management, environmental management or any climate change/ disaster management related discipline.	
2.2. Quantitative assessment of the consultant firm’s Methodology and Approach of undertaking the assignment The extent to which the Applicant proposed methodology, timeline and plan to undertake the consultancy assignment. This sub-criterion is evaluated on the basis of the application technical proposal submitted.	20
2.3 Quality of the application and proposal to the TORs?	5
Technical Total Score	70
3. Financial Proposal	30
Overall Score	70+30= 100

J. Recommended Presentation of Offer

- a) Duly accomplished **Letter of Confirmation of Interest and Availability** using the template provided by UNDP;
- b) **Team’s individual personal CVs or P11**, (Team leader and team members (two)) indicating all past experience from similar projects, as well as the contact details (email and telephone number) of the Candidate and at least three (3) professional references;
- c) **Technical proposal**: description of why the individual considers him/herself as the most suitable for the assignment, and a methodology, on how will s/he approach and complete the assignment.
- d) **Financial Proposal** that indicates the all-inclusive fixed total contract price for the assignment.