

**TERMS OF REFERENCE
FOR
ASSESSING VULNERABILITY OF SAGARMATHA NATIONAL PARK AND BUFFER ZONE
AND
FORMULATION OF THE COMMUNITY BASED ADAPTATION STRATEGIES**

I. Background:

The Himalayan region having glacier coverage of 33,000sq km- aptly called the “Water Towers of Asia” as it provides roughly 8.6×10^6 cubic meter of water annually (Dyurgerov and Maier, 1997)- stretches across 2,500 kilometres with a width of between 150 to 200 kilometers. The Himalayan Mountains are the youngest, largest and highest mountains in the world. Home to millions, they have major influence on the region’s weather, and provide a water tower that supplies and regulates water for billions of people living downstream. Moreover, due to their unique position and physical features, they act as a storehouse of valuable biodiversity resources and hold a mosaic of age-old human cultural diversity.

Climate Change is becoming one of the major threats in the Himalayan region. Changes in ice occurrences and corresponding impacts on physical high-mountain systems are among the most directly visible signals of global warming. Sagarmatha area is not exceptional in this case. The glaciers of this region is retreating at the fast rate than expected resulting to the formation of glacial lakes which may result to disaster events like glacial lake outburst flood (GLOF) making local people and biodiversity in great threat from its impact.

In Nepal there is a paucity of information on Himalayan wetlands making it difficult to get a clear idea on their status especially with regards to the threats and their management. Hence, the conservation and wise use of these have not got adequate attention, resulting into deterioration of water bodies in terms of water quantity, quality and area due to natural and anthropogenic activities. Beyond these problems, there are knowledge gaps, lack of technical know-how for management and inadequate policy advocacy, which has direct impact on the management of HAWs.

WWF Nepal, together with the Department of National Parks and Wildlife Conservation (DNPWC), has conducted a research on the inventory of Gokyo lake system in 2005. Realizing its biological and cultural significance, DNPWC with the support of WWF Nepal has prepared a Ramsar Information Sheet to be submitted to Ramsar Bureau for the declaration of Ramsar Site. It will be the first Ramsar site in Nepal in the high mountains.

The vulnerability assessment of the Sagarmatha National Park from climate change angle at a general level is highly required. It is believed that this area is being impacted by climate change but there is a need to verify it with some facts and figures. There area also many pocket area where there is high need to develop an adaptation strategy to reduce the threat from climate change impact. Implementing the adaptation strategy in these vulnerable sites need to be prioritize.

The Gokyo lake system is naturally vulnerable, as it is lying in an ecologically fragile and unstable zone. The outburst of Ngozumpa glacier is always a threat to the existence of the lakes. The people residing near the lake and the tourists visiting that area are also in danger due to the potential of GLOF. The scientific study of the hydrological regime has not been conducted yet.

Ghat area lies in the bufferzone of the Sagarmatha National Park in Chaurikharka VDC. In 1985 the GLOF that result from Dig Tsho Glacial Lake had highly impacted this area. After the GLOF that resulted from Dig Tsho Glacial Lake, the topography of this area has been changed. It is predicated that if again the GLOF from Imja Glacial Lake happens than this area will be highly impacted. However there is a need of scientific study to verify this fact and also there is a high need to developed and implement the adaptation strategy of this area.

II. Objectives of the study:

The main objectives of the study are:

1. To assess the vulnerability to the effect of climate change on freshwater and its impact on the livelihood of people living downstream on the given study areas;
2. To prepare community based adaptation strategies with regard to the impact on freshwater in the study areas

III. Study Area:

A. Sagarmatha National Park:

Sagarmatha National Park, a World Heritage Site was declared as a protected area in the year 1976. It covers an area of 1,148 sq. km. of mountain ecosystem. The park is largely composed of the rugged terrain and gorges of the high Himalayas ranging from 2,845m at Monju to the top of the world, Sagarmatha (Mt. Everest) at 8,848m above sea level. Other peaks above 6,000m are Lhotse, Cho-Oyu, Thamserku, Nuptse, Amadablam, and Pumori. The park is visit by thousands of tourists every year. Therefore mainstay of local people living inside the park is hotel business catering services to trekkers and mountaineers.

The park includes the upper catchment areas of the Dudh Kosi and Bhote Kosi Rivers. It has large number of glaciers situated at the head of Khumbu valley. Khumbu, Lhotse, Imja and Ngozumba are few examples of large glaciers.

Further, increasing trend in annual average temperature since 1977 shows that there has been significant rise in trans-himalayan and himalayan region (0.09°C) in comparison to over all country (0.06°C). Since the warming is more prominent in the high altitude, it poses more serious impact to our ice cover land and glaciers.

B. Gokyo lake system:

Gokyo lake, situated at the base of Mt. Everest and partially fed by the Ngozumpa glacier, is one of the most popular tourist destinations leading to Everest Base Camp in Sagarmatha (Everest) National Park. At

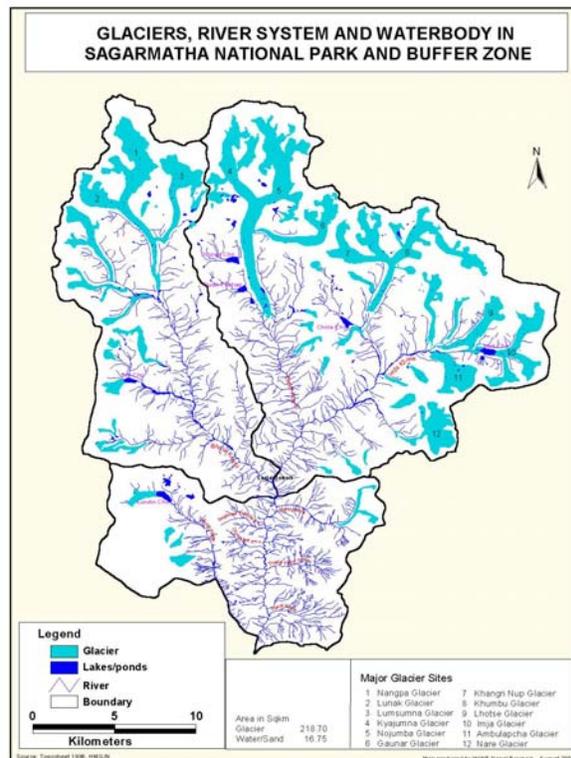


Figure 1: Glaciers, river system and water body at SNP

an altitude of 4734m, the lake is a source of permanent fresh water and has high hydrological values. Home to endangered species like snow leopard and musk deer, it also provides breeding ground for migratory birds. The Gokyo Lake is also considered a sacred lake for Hindus and Buddhists, where about 500 Hindu people take a holy bath during the Janaipurnima festival, which usually occurs in the month of August. On an average 7,000 tourists annually visit the Gokyo Lake

Gokyo lake system lies between the altitude ranges of 4600-5100 m in Khumjung VDC of Solukhumbu district, and is the main wetland site in the Park. The largest glacier Ngozumpa is the main sources of water for Gokyo. The wetland lies on the head of the Dudh Koshi River which descends from world's 7th highest mountains - Cho Oyo. There are five major lakes in Gokyo cluster, out of which Gokyo, also called Dudh Pokhari/ is the main lake (42 ha), followed by Taujon Cho (17 ha), Thonak Cho (65 ha), Ngozumpa Cho (14 ha) and Gyazumpa Cho (29 ha). The Gokyo lake feeds waters from various sources such as seepage from the Ngozumpa glacier, a stream coming from the Renjo La pass from north-west and another stream originating from the Ngozumpa glacier in the east. It is a glacier-fed freshwater wetland and discharges water to the Dudh Koshi River headway via the Taujun Lake and the Longabanga lake. No direct/visual connection between the Gokyo Lake and the upper Thonak Cho and the Ngozumpa Cho has been observed but these lakes may be connected via underground seepage water. The margins of the Gokyo Lake which is connected with streams in the form of inlets and outlets create marshes or swamps along their marginal meadows.

The study area encompasses the Gokyo lake system including the major lakes as below:

Main Lakes around Gokyo in Sagarmatha National Park, Nepal.

Lake Name	Associated Wetland Number	Latitude	Longitude	Area (ha)	Mean Length (m)	Elevation (m)	Orientation
Thonak Cho	4	27°58.49'	86°40.99'	65.07	1925	4834	SE
Gokyo Cho (Dudhpokhari)	3	27°57.02'	86°41.58'	42.69	975	4734	SE
---	5	27°56'	86°42'	29.00			
Tanjung Cho	0	27°56.43'	86°42.11'	16.95	700	4728	SE
Ngojumba Cho	2	28° 0.31'	86°41.09'	14.39	585	4950	SW
Longbanga Cho	0	27°55.8'	86°42.36'			4710	SE
Total 6	14			168.11 ha *			

* This does not include the area of Longabanga lake (Source: ICIMOD 2002 and field survey August 2005).

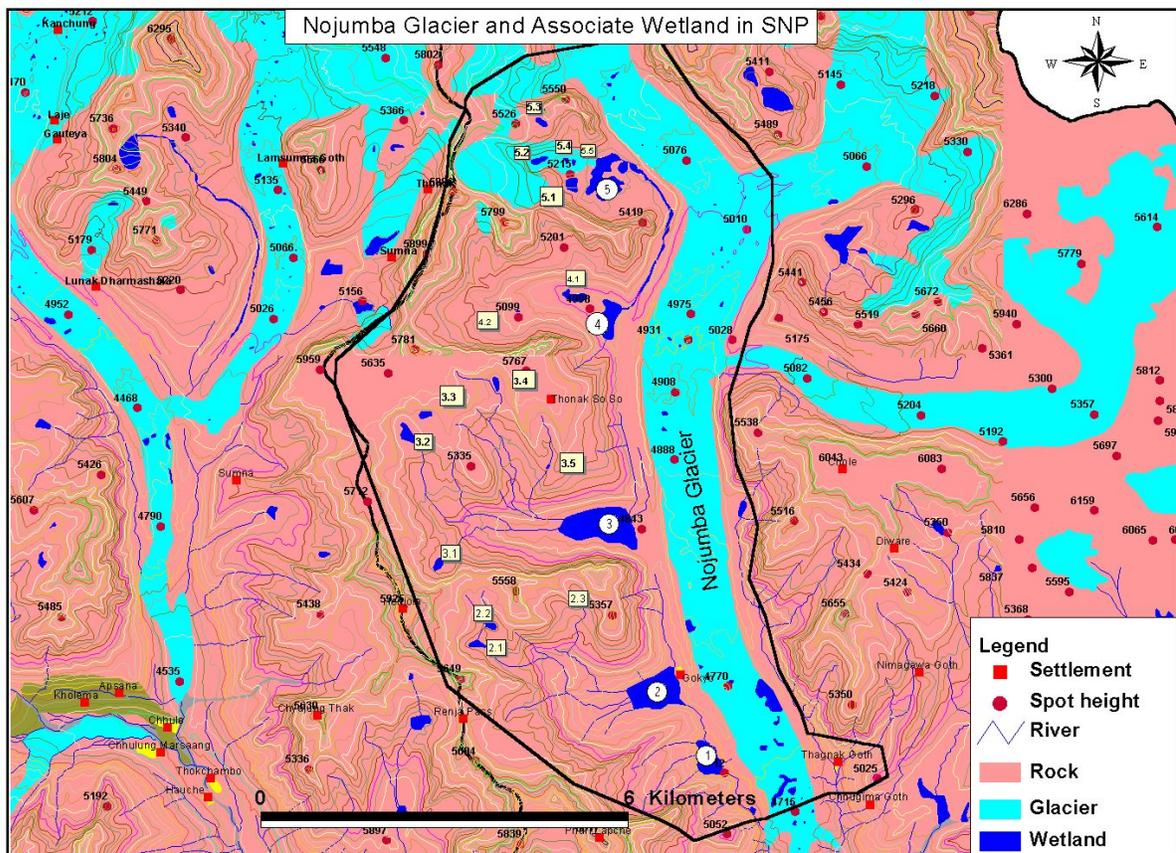
Boundary of Gokyo lake series with Ngozumpa glacier (Map below)

East: Ridge west of Thangnak village that joins with the Ngozumpa glacier.

South: The meeting point of water discharge from Gokyo lake series and Ngozumpa glacier.

West: Ridge above Lake 1 to Ngozumpa glacier along with Gokyo lake that borders with the Thame side.

North: Ridge above Ngozumpa Glacier Lake.



C. Ghat Area:

Ghat area lies in the bufferzone of the Sagarmatha National Park of Chaurikharka VDC at an altitude of 3750 meter above sea level. This area lies on the way to the Namche and the main income of from tourism. Few community forests exist in this area. With the Dodh Koshi River in the west, this area consists of few eye catching fauna species also.

The Glacial Lake Outburst Flood (GLOF) that came from Dig Tsho Glacial Lake had highly impacted this area. Few houses including the fertile land, cattle were washed away by the GLOF of 1985. The topography of this area was changed by this GLOF and still its remain can be seen. If the GLOF from Imja Glacial Lake happens than this area will be completely wash away. However there is a need of scientific study to verify this fact and also there is a high need to developed and implement the adaptation strategy of this area.

IV. Methodology:

The study should include (but not limited to) following steps described as below:

1. **Research on flow regime and hydrological cycle in relation to the Ngozumpa glacier:** Secondary data will be collected by reviewing and compiling all the pertinent information from documents produced by various organizations and individuals. Based on this and consultations with WWF and the relevant stakeholders, different sites will be selected for field visit and primary data collection.

2. **Vulnerability assessment to identify the potential threats and major impact zones:** GIS modeling and mapping will be done in order to identify the potential threats as a result of climate change and vulnerability assessment of the major impact zones and the communities downstream.
3. **Formulation of the community based adaptation strategies:** On the basis of secondary data collected and the primary data from the field, various community based adaptation strategies to cope with the possible freshwater issues affecting the livelihoods will be prepared in consultation with the local communities, CBOs, NGOs and Government line agencies.

V. Expected Output

1. Document on Vulnerability assessment as a result of climate change and its impact on livelihood of people downstream including the following aspects:
 - flow regime and hydrological cycle
 - identification of the vulnerable communities and the major impact zones in case of hazards
2. Document on community based adaptation strategies to cope with freshwater hazards due to climate change phenomenon in the affected communities

VI. Deliverables

1. Workplan of the assignment by **31 January 2007**
2. A research design for primary data collection submitted to WWF Nepal by **31 January 2007**
3. Preliminary draft report (digital and hard copy) of the assignment by **15 March 2007**
4. Revised report after the incorporation of comments from experts (digital and hard copy) by **2 April 2007**
5. Final report (digital and hard copy) of the study by **10 APRIL 2007**
6. Raw Data after the completion of field work by **10 APRIL 2007**
7. Photographs and negatives, if taken by **10 April 2007**
8. Financial report with all relevant documents by **10 April 2007**
9. Other relevant documents procured/purchased under this contract by **10 April 2007**

VII. Duration of assignment: 2 man month (60 days) in the period between 15 January 2006 – 13 April 2007