ABSTRACT

Glaciers are often regarded as a barometer of climate change, especially the increase in temperature. Glaciers of Nepal Himalaya have significant significance because these glaciers, in addition to their role in the hydrological cycle, supply more than two-thirds of water flow to the Ganges River during the dry season supporting the livelihood of a major portion of 410 million people residing in the Ganges River basin. Because of global warming, average annual maximum temperature in Nepal is calculated to be increasing at the rate of 0.06°C whereas the world average is just 0.0074°C indicating a very high rate of temperature increase in the Nepal Himalaya. So, there is an urgency to study the glaciers of Nepal Himalaya. In this context, this study aimed at reviewing the results of previous studies on glacier changes and carrying out a first-hand study on the behavior (retreat or advancement) of glaciers of the Manaslu Himalayan range. The aggregate results indicate that though some glaciers are advancing or stationary, the majority of them are retreating. We recommend a comprehensive study on the glacier area/volume changes and formation of glacial lakes in the Nepal Himalaya so as to have a better and precise national level understanding of the issue and its potential impact downstream.

KEY WORDS:

Glacier retreat, Nepal Himalaya, Manaslu, Climate Change

INTRODUCTION

With the recent global debate on climate change, glaciers have got more attention because of their potential to serve as a barometer of climate change, especially the changes in the temperature. The glaciers have a significant role in maintaining global and regional climatic and hydrological systems, and supporting livelihood of millions of people downstream as a source of fresh water for drinking and irrigation.

Glaciers of the Himalaya are one of the largest ice deposits outside of the polar region covering an area of 35,110 square kilometers with a total ice reserve of 3,734.5 cubic kilometers (Qin, 2002 as quoted in Jianchu et al., 2007). Out of the five major drainage basins of Himalaya, Ganges river basin is the largest basin covering nearly 50% of the area and more than half of the total ice volume. Ganges river basin is densely populated (401 persons per square kilometers) supporting life of 410 million people which is the highest among all the Himalayan river basins (Jianchu et al., 2007). Nearly two-thirds of the people living in the Ganges River basin are dependent on agriculture as their major occupation. The Himalayan glaciers and rivers provide water for agriculture and drinking in the area. In Nepal, there are 3,252 glaciers covering an area of 5,322 square kilometers and an estimated ice reserve of 481 cubic kilometers (Mool et al., 2001). Most of the Nepalese rivers are glacier fed and drain into the Ganges River. Importantly, during the dry season, Nepalese rivers contribute 70% of flow in the Ganges River (Alford, 1992). So, the glaciers of Himalaya in general, and those of Nepal in particular, are of very high importance to maintain the regional water balance and to sustain the life of 410 million people in the Ganges River basin.

Because of global warming, the temperature is increasing in the Himalayan region also. Average annual maximum temperature (1971-1994) in Nepal is calculated to be increasing at the rate of 0.06°C (Shrestha et al., 1999) whereas the world average is just 0.0074°C (IPCC, 2007) indicating a very high rate of temperature increase in the Himalayan region. This increase in temperature causes increased melting of glaciers which will increase water flow in the river temporarily resulting on decreased ice/snow mass balance. It will, in long-run, because of decreased ice/snow mass balance cause decreased water flow in the river. Moreover, because of increased temperature there will be less precipitation in the form of snow which will cause reduced accumulation of snow and ice. It will contribute to decreased water volume. A study on the rate of glacier retreat in the major mountain systems
of the world shows that the glaciers in the Himalayan region are retreating at the rate of 0.3 to 1 meter per year which is the highest among all (Dyurgerov and Meier, 2005). So, the Himalayan glaciers are at very high risk of disappearance in the future which ultimately will have negative impact on climatic, environmental and socio-economic systems in the downstream area.

METHODOLOGY

Review of available literatures was done to compile information on glacier status and changes in the Nepalese Himalaya. A study using GLIMS database (Bajracharya, 2008) and a glacier boundary delineated using a satellite image of 2008 was done to see the changes in selected glaciers of Manaslu Himalayan range.

RESULTS AND DISCUSSION

Yamada et. al. (1992), in their study of glaciers of Khumbu region, found that during the period of 1970s to 1989 they retreated with an annual rate of 30-60 meters. Shorong Himal glacier was found to be retreating with an annual rate of 30 meters during 1978-1989 (Fujita et. al., 2001) corresponding to 12 meters lowering of its surface.

In the Ghunsa River basin of Taplejung district bordering India in the Eastern Nepal, Asahi and Watanabe (2000) found that out of 57 glaciers, 50 percent showed retreat, 12 percent showed advancement while the remaining were stationary during 1958-1992.

A study of 24 glaciers of Dudh-Koshi basin in Eastern Nepal for the period of 1960 to 2001 revealed that their retreat rate varied from 10 to 59 meters per year (Bajracharya et. al., 2007). They surprisingly noted that, during five years (2001-2006), Imja glacier had a retreat rate of 74 meters per year which was even higher than its retreat rate of 59 meters per year for the period of 1960-2001.

Bajracharya and Mool (2005) reported that Trakarding glacier (on the south western slope of Manaslu Himal) was retreating 66 meters per year (1957 to 2000). Reviewing various studies, WWF-N (2005) confirmed that glaciers in the Hidden valley region of Dhaulagiri Himal showed the general trend of retreat.

Salerno et. al. (2008) studied variations in the surface area of glaciers in Sagarmatha National Park (Mount Everest region) for the period of second half of the 20th century. They found an overall decrease in glacier area by 4.9% (from 403.9 to 384.6 km²) in four decades. They found that some large glaciers situated at higher altitudes, mainly those oriented to the south, increased in area whereas the small glaciers at lower altitudes and steep slopes experienced a reduction.

Our analysis of two glaciers in western part of Manaslu Conservation Area showed that during the period of 1962 to 2008, the glaciers retreated at the rate of 11 to 14 meters per year (Figure 2). The literatures reviewed and our analysis in Manaslu area show that Nepalese glaciers are in retreating stage.

Owing to different years, scale and unit of analysis, and different data sources used by various studies reviewed in this paper, the results are not directly comparable to each other in all the cases. Moreover, most of the studies on glaciers are concentrated in eastern region with few on central region but virtually none in the western part of Nepal. So, it is almost impossible to draw scientifically justifiable conclusion at national level with the studies carried to date in Nepal. Further studies on the aerial and volumetric changes of glaciers representing the variation in
longitude, latitude, altitude, slope and aspect are necessary for this purpose. It will also help us to identify factors responsible for changes in glaciers of the Nepal Himalaya.

CONCLUSION

We conclude that glaciers in the Nepal Himalaya are retreating in totality. The impacts of such retreat will be mostly negative and it will affect biodiversity, ecosystem functioning, socio-economy and health of the people downstreams. The negative impacts will further be compounded by glacial lakes outburst floods. Therefore, we recommend a comprehensive study on the glacier area/volume changes and formation of glacial lakes in the Nepal Himalaya so as to have a national level understanding of the risk associated and potential impact downstream to other countries.

REFERENCES

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