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Report to
King Mahendra Trust for Nature Conservation
and
Annapurna Conservation Area Programme

PILOT STUDIES IN ANNAPURNA CONSERVATION AREA

**THE EFFECT OF GLACIER MELTWATER ON
AN AGRO-PASTORAL SOCIETY IN HIMALAYA**

Project leaders

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BAKCGROUND

Fresh water is a finite and vulnerable resource, essential for sustaining life and development. The water resource in Himalaya is partly stored as glacier ice, i.e. **capital water**. There are approximately 70 larger glaciers in Himalaya covering about 166.12 km² or 17 % of the mountain area. This is the largest body of ice outside the Polar ice caps, and forms a unique reservoir, which supports mighty perennial rivers such as the Indus, Ganges and Brahmaputra, lifelines of millions of people.

The dynamics of the 'ice-to-water' transition are full of uncertainties and hazards, such as glacier lake outbursts, floods and avalanches. Glaciers may also expand into the cultivated landscape as took place during the **Little Ice Age**. Societies located close to glaciated areas, which are dependent on the meltwater for primary production, are very vulnerable to changes on extent of the glacier. Most glaciers expanded during The Little Ice Age, which was a global cooling period (c. AD 1350 to 1850). Glaciers have been retreating since the Little Ice Age, and acceleration of the this retreat has been observed in Himalaya since c. 1970, probably due to the '**green-house-warming**'. The International Commission for Snow and Ice (ICSI), claims that glaciers in the Himalaya are receding faster than in any other part of the world. According to the Working Group on Himalayan Glaciology, the Himalayan glacier may disappear during the next century if the present rate of retreating continues. The consequences for the local populations are also highest in the central and eastern Himalaya because, compared to the rest of the world, the population density near glaciers in this region is very high. It is assumed that most people living in such areas are dependent on the meltwater for both agriculture and pasture land. The effect of increased glacier melt is both local and regional.

LOCAL CONSEQUENCES OF GLACIER RETREAT IN UPPER MANANG

The Gangapurna glacier lies face to face with the village of Manang at 3600 m a.s.l. in central Himalaya, Nepal (84.00' E, 28.41'N). This is north of the massive Annapurna range and lies in the rain shadow, so that the monsoon only brings an

annual rainfall of 400 mm. Old people in Manang village claim that the glacier has retreated more than 150 metres over their lifetime, and that the volume of water in the streams that descend from the glaciers has decreased markedly. Water from the streams is used to irrigate the village fields, but today there is a lack of water.

This pessimistic view may be alleviated by the fact that glacier retreat may open new potential areas for grazing and forestry, but relatively low temperatures and a short growing season at this elevation may slow down the development of vegetation in the deglaciated areas (i.e. slow primary succession).

Goals and objectives

The effect of glacier retreat on the agro-pastoral activity may be formulated in two alternative working hypotheses:

- (1) There will be increased meltwater runoff, and an increased area for potential primary production.
- (2) there will be a reduction in available meltwater to vegetated areas, and reduced primary production

The primary goal is to establish the relationships between primary production (natural and cultural) and the meltwater from the retreating glacier.

Glacier history

The history of the glacier over the last 150 years was surveyed on the basis of the terminal and lateral moraines. The terminal moraines that indicate stages in the retreat from the maximum expansion. The oldest moraines on north side of the Marsayandi river are adjacent to the present day agricultural fields . These are most probably for a neoglacial period (2000 Before Present), but they may also have been formed during the maximum extent of the little ice age (c. 1850 AD)

These moraines are today used as cemetery area, and several chortens are located on moraines. This tradition is probably 100 years old (oral information).The terminal moraines on south side of the Marsayandi river are formed the last 100 years and the glacier lake are only c. 50 years. The glacier have retreated c. 2 km the last 50 years.

Written information on earlier catastrophic events from monastery was not possible to obtain since all such material had been destroyed, and the remains had been put into concrete walls for safety.

Agriculture

Observations indicated that agriculture production is totally dependent irrigation water from the tributary rivers to the main Marsayndi. These river have their resources from glacier and snowmelt areas and will be depend on the future of these glacier systems. The survey indicated that some smaller glacier which do not have their main masses above 5500 masl may disappear rather rapid (within this century). However large glacier with the main glacier-ice masses above 5500 masl will probably not disappear in the nearest future. Irrigation of the agriculture fields is done both in spring and fall season. The channels seem to be well conserved and there was no sign of malpractice related to the channel system.

The agricultural production has changed from primarily potatoes and barley to mainly wheat and buckwheat. One may hypothesise that the change from barley to wheat is related to the growing tourist business, which consume a lot of wheat based products.

Vegetation

The development of the vegetation on recently deglaciated areas (i.e. primary succession) was surveyed. The vegetation is used for grazing by domestic animals (yak, goat, and sheep), but is not a major grazing resources since the vegetation is still in a young successional stage, or the habitat is too dry to have a rich vegetation. The best grazing areas are found along the flat tills along the Marsayandi river. This is partly rainfed, but it is also receive some of the glacier meltwater from the rivers. In relation to this survey the preliminary analyses indicates that there is no sign of over-grazing. There was indication that high species richness is associated with rather low biomass, thus grazing should not be restricted or reduced form the present day level.

Forest

The second visit to the area focused primarily on the forest of *Pinus wallichiana* (The Himalayan Blue Pine) and its colonisation of the glacier-foreland. There is rapid colonisation of *Pinus* trees on the lateral moraine on both sides of the Gangapurna glacier. The same is observed on the glacier close to the Minerepa cave (opposite Braga). Here the *Pinus* trees have actually developed into a forest on the lower part of the bottom moraine debris in front of the glacier. Areas such as this will be an important forest resource if they are allowed to grow to a mature stage.

There are some signs of bark cutting in mature forest, which will eventually kill the tree, and it can legally be used for fuel-wood. The forest litter (pine needles) is the main part (together with dung) of the compost that is used for agriculture fields. Thus this it is very important that these forests are well managed, since their products are vital for the agricultural management.

On the other hand, there are also signs of under-use. In the *Abies spectabilis* forest along the path to the Minerepa cave there are many dead logs in the forest that could have been used for fuel-wood. At present they will just decay. Although this will benefit the forest ecosystem on the long run it could easily be used for fuel if modern technologies, such as motor saw, were available.

CONCLUSIONS & RECOMMENDATIONS

>The agriculture is totally dependent on glacier meltwater

>The glacier in upper Manang have retreated very rapid. Those glaciers that extend above 7000 masl will probably remain for a much longer time than smaller glaciers with main ice masses below 5500 masl (e.g. 'Minarepa-cave –glacier').

>The forest tree, *Pinus wallicina* (The himalayan blue pine), is colonising newly deglaciaded areas very quick, and will be an important forest resource in the future. The Mature forest are at some locations over-utilised, but there is also some sign of under-utilisation.

>The newly deglaciaded areas is at present not important as pastures. The main pastures are found in the bottom of the U-valley. The grazing pressure here is rather too low than too high. Thus grazing pressure should not be reduced.

Duration and Participation:

Two visits were done to upper Manang valley one from 15.09 – 20.10. 2000 and one from 23.04 to 05.05.2001.

Personell

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