

BACTERIAL CONTAMINATION IN THE SURFACE WATERBODIES IN SAGARMATHA NATIONAL PARK AND BUFFER ZONE, NEPAL

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Abstract: Sagarmatha (Mt. Everest) National Park is a popular international eco-tourist destination. Tourist flow has increased highly in the last few years causing anthropogenic pressure on the natural environment. To assess the river water quality, regarding to bacterial contamination was analyzed between 2008 -2010. One hundred and thirty five water samples of the surface water from near the trekking route were analyzed. Fecal contamination was found near some sites along the trekking routes. Unscientific solid waste management, open defecation and poor condition of septic tanks; and direct disposal of toilet waste into the water courses or on the exposed surfaces, were major sources of bacterial contamination.

Keywords: Contamination; Garbage pit; Septic tank; Toilet.

INTRODUCTION

The Sagarmatha National Park (SNP) located in the District of Solukhumbu, Nepal, is privileged with the Mount Everest, the highest peak of the world and many other peaks over 7000 m. The Sagarmatha National Park (SNP) was established in 1976 and declared as a world Natural Heritage Site in 1979. It is a popular eco-tourist destination for international community. Since the first ascent of Mt. Everest in 1953, around half a million trekkers (national & international) visited the SNP. The number of tourists in the Khumbu region was 20 in 1964, which rose to 32,123 in 2009 and 32,084 in 2010. In addition to international trekkers, a large number of people visit the SNP as porter and guide. On one side, there is economic gain through tourism in the Khumbu region; and on the other side it has produced some environmental concern (Caravello *et al* 2007).

Tabei (2001) reported that a trekker leave around 51 kg of garbage in the route to Mt. Everest i.e., around 305 g per trekker per day. The amount of urine per person per day at high altitude was estimated to be 2.16 liter. Tabei (2001) calculated and reported that 615,520 liter urine was left on the Khumbu glaciers up till 1999 by trekkers and 92,780 liter by Sherpas.

The pollution of water sources is caused by toilets

too close to streams and drinking water sources. Water pollution is exacerbated by disposing human waste directly into rivers and streams customarily done by owners of tea shops and small lodges. Presence of solid waste and microbiological contamination in some water bodies of SNPBZ were found (Ghimire *et al* 2010). Hence, the present study was conducted in order to find out the state of more water bodies of the SNPBZ.

STUDY AREA

The SNP located in the southern slope of Sagarmatha (Mt. Everest), lies in the Solukhumbu district of the north eastern region of Nepal. The park is characterized by rugged topography and covers 1,148 sq km. The altitude of park ranges from 2,845 m at Jorsalle to 8,848 m at the top of the Mt. Everest. The Sagarmatha region is drained north to south by three major rivers namely: Dudh Koshi, Bhote Koshi and Imja Khola. Dudh Koshi originates from Ngozumpa glacier and Imja Khola from Khumbu glacier and Bhote Koshi originates in Tibet to meet Dudh Koshi at Larja dohan below the Namche Bazaar. Several tributaries feed these major rivers. Tourism is a major source of economy of Khumbu region but still a large number of people depend upon agro-pastoral activities. A total of 1,288 households with 5,869 people inhabit the Sagarmatha National Park and Buffer Zone (SNPBZ).

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MATERIALS AND METHODS

Field visit and sample collection

Three visits to SNPBZ were made in 2008, 2009 and 2010. The sampling sites were selected mostly along the trekking routes from Lukla to Everest base camp, Gokyo, Imja Lake and Thame. The criteria of selection of sampling points were based on outflow region of lakes, vicinity of tourist trail, location on the bank of wetlands and sources of major river system.(fig.1)

Sample preservation and transportation

Water samples were collected from the waterbodies in polythene bottle of 125ml capacity. Forty five samples collected in every visit were brought to Kathmandu preserved at 4°C and analyzed in Ecology lab of Central Department of Botany, T.U, Kirtipur in 2008 and 2009 respectively, where as forty samples of 2010 were analyzed in the lab of Khunde hospital .

Laboratory analysis

Bacteriological analysis was done in a temporary lab established by Ev-K2-CNR at Sherpaland Hotel in Namche, and at Central Department of Botany (Tribhuvan University, Kathmandu). Total coli forms and *E. coli* estimation. It was done by most probable number (MPN) method following APHA (2005).

RESULT AND DISCUSSION

Bacterial presence (*Escherichia coli* and *Streptococcus faecolies*) was recorded in the water samples collected from spring at Phakding , between Jorselle and Dudhkoshi bridge ,Namche Bazaar (near garbage pit),Pheriche, Phunki Tenga Dudh Koshi, Thado Khola at Phakding, Everest Base Camp, Machhermo Khola, Bhote Koshi below Thame (Fig. 2).

In residential areas, forest litter is used in toilets instead of water. Therefore, the so called “septic tank” is the site for composting manure used in agriculture lands. Direct leaching of pollutants from such septic tank and subsequent contamination of water bodies could be negligible. However along the trekking routes, a significant number of tea shops and a few hotels did not have septic tanks. For example, at Jorsalle hotels/tea shops lying towards the river bank did not have septic tank and effluent from the toilets (which used water) opened to the cliff on the bank of Dudhkoshi. The coliform bacteria are present in very high numbers in fecal contaminated waters (WHO 2008).

The condition of toilets and septic tanks in the Khumbu region is not satisfactory. The situation of public toilets and their septic tanks (at Namche, Chukung) was the worst. No construction of septic tanks (e.g. at Somare, Pheriche), leakage from septic tanks (e.g. at

Gorakhshep), no construction of toilets (e.g. at Thamo), and high permeability of the septic tanks were the common problems.

The solid waste generated from the hotels and open toilet sites and its deposition is ultimately leaching to Gokyo lake (Dudh Kunda) that passes through lake number1(starting counting from South-Longabanga Tsho/lake) and lake number 2 (Taujun Tsho) and reaches to the Dudh Koshi river. During Janai Purnima (July/August) festival, over 500 pilgrims take sacred bath in the lake. In the tourist seasons, sometimes camps haphazardly erected nearby the lake and contribute to pollution, especially from their abandoned items, adding the amount of waste.

At Somare, a tea shop area next to Pangboche, at least two toilets had no septic tanks and effluent directly contaminated a small spring passing from the area. At Pheriche, at least four hotels had toilets on the river side of the route but without wall towards the river side, allowing whole content to flow out. This could directly contaminate Lobuche river when water surface rises during rainy season. At Gorakhshep, we could see semi-solid human excreta on the surface that leached out from “septic tank”. The drinking water used by hotels show high levels of total coliform indicating high fecal contamination from other animals and aquatic birds (WHO 2008). In some cases, lodges had cemented toilets, but had no septic tanks and discharged the waste directly to water bodies (e.g. Phakding, Jorselle). Therefore, the water bodies in these sites were contaminated with bacteria. Sharma *et al* (2010) also found most contaminated water near hotels.

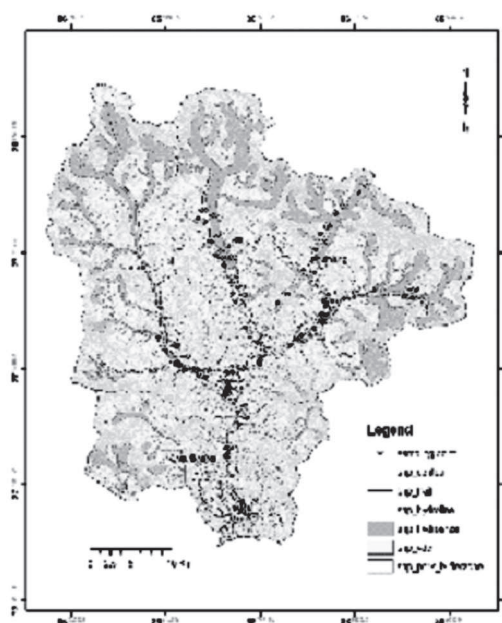


Fig 1: Map showing samplings points in SNPBZ

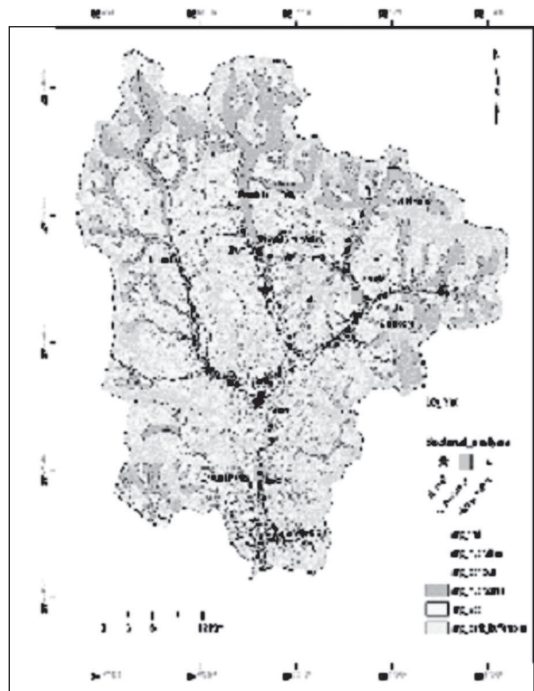


Fig 2: Bacterial contamination in river water bodies in SNPBZ

CONCLUSION

The contamination with fecal coliform of most waterbodies in the SNPBZ area was low but showed increasing trend of contamination. *Escherichia coli* and *Streptococcus faecolies* bacteria were recorded in some waterbodies in the Sagarmatha National Park and its Buffer Zone (SNPBZ). Improvement in the conditions of toilets and septic tanks can prevent the movement of pollutants from sources to the water bodies.

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