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PUBLIC HEALTH QUALITY OF ATTAABAD LAKE WATER OF GILGIT-BALTISTAN, PAKISTAN

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ABSTRACT

A devastating landslide at Attaabad in Gilgit–Baltistan region of Northern Pakistan took place on January 24, 2010 that obliterated the village Atta Abad killing 20 persons, and creating a lake on the Hunza River. This lake grew to more than 23 km length and submerged a 22-km stretch of the Karakoram Highway (KKH), a trade route for consumer goods from China. About 5,000 families in the Upper Hunza Valley were isolated from the rest of the country. Many upstream villages including Ainabad, Shishkat, Gulmit and Hussaini were evacuated due to rising water levels in the lake. The present study focused on the public health quality of Attaabad lake water. Samples were collected from the lake to determine the physical and chemical quality of the lake water. All the samples were found fit for human consumption chemically or microbiologically. However, the lake needs immediate protection from anthropogenic pollution which is likely to occur in future and may effect the down stream population.

Key-words: Attaabad Lake, landslide, Public health water quality, Gilgit-Baltistan, Pakistan.

INTRODUCTION

The northern areas of Pakistan were designated as FANA (Federally Administered Northern Areas) till August 8, 2009. On August 9, 2009 the Government of Pakistan changed its name and now it is called Gilgit – Baltistan governed by a Chief Minister under the rule of a governor.

Gilgit-Baltistan is located at 72^0 75^0 E and 35^0 37^0 N having seven districts. Hunza is one of the ancient and important districts of Gilgit-Baltistan. This mountainous valley is situated at an elevation of around 2500 m. The total area of the valley is 7,900 km^2.

Gojal a subdivision of the Hunza Nagar district of Gilgit-Baltistan. Gojal is the largest subdivision of Gilgit-Baltistan that spreads over an area of about 8,500 sq.km at an elevation of 2,340 to 4,877m. The Gojal valley borders internationally with the Xinjiang province of Peoples Republic of China and Wakhan corridor of Afghanistan. The present study focused on the four main villages of Gojal that were adversely effected by a the landslide.

Attaabad

Attaabad completely destroyed by the land slides. It was located at about 10 km upstream of Karimabad, high up on west side of Hunza valley recognized by a pasture land surrounded by natural slopes with sparse vegetation. The village was just below the snow line. The local Attaabad peak to the north is at 5184m and this ascends to the northwest up to Ultar Peak at 7388m. The area was approached through the crossing at the Hunza River, off the Karakoram Highway. The village was about 2500m above sea level. This area receives about 150mm to 300mm of snow and very little rain during a year. Temperature hardly exceeds 30°C in summer.

Shishkat

This is Burushaski speaking village comprising of a population of 2160 with 220 houses. This is the first village of Gojal when crossing to central Hunza. The village was established in 1903 prior to that it was a barren land used for grazing domestic animals of Gulmit village.

Gulmit

The largest village in Gojal is Gulmit with a population of over 2,000 with 308 house holds (www.gojal.net). It is located at an altitude of about 2703 m at a distance of 135 km both from Gilgit city and Khnjarab pass (www.gojal.net). The village is central place providing goods and other services to neighboring villages. The central shopping area where over 30 shops exist selling different commodities for daily use. In 1962 a post office was established that provides services to the surrounding villages. This village in fact has a better standard of living **(**Rehmat,http://www.psgis.org/ejournalFeb2006.html) as compared to other areas of Gojal.

Hussaini (36°26′53″N 74°54′04″E36.448°N 74.901°E)

It is rocky valley which is 145 km from Gilgit city. Hunza River flows into the east while Karakorum highway (KKH) passes to its west. It is located at an altitude of 2556m. The population is > 500 people living in 75 houses.

According to Khan (2010) the over all environmental health conditions in the region are poor. Health survey demonstrated that the largest health problems in the region include pneumonia, diarrhea, and eye diseases (AKHSP, 2003).

The event of landslide and formation of Attaabad Lake

A crack in the ground was noticed by the residents of Attaabad in February 2003. The crack was traced uphill through steep scree slopes. It became progressively larger as it reached the mountain rock face. It then swung back downhill to the point of intersection with the Hunza gorge cliff edge where it passed through some houses. It is generally believed that crack was developed followed by earthquake of magnitude 6.5 that occurred at the Astor Valley (E 74°.45" N35°.30") in November 2002. Hayat *et al.*, (2010) reported that Astore earthquake was the major triggering factor for the Attaabad landslide The impacted site of Attaabad is on the fault line which is about 30 km upstream of Aliabad, 10 km upstream of Karimabad; about 10 km downstream of Gulmit, and 25 km downstream of Hussaini village. Hussain and Awan (2009) already reported that a fault is passing through the affected area. Based on the study of Hussain and Awan, (2009), the area of Attaabad was declared as high hazard one. The original crack width was getting larger but it was not correctly interpreted when it was suggested that it appeared not to be getting longer. Tension cracks are indicative of slow moving but imminent disaster.

The landslide of Attaabad created the landslide dam across the Hunza River. The landslide dam is approximately 1200m long, 350m wide and 150m high (Leonard, *et al.*, 2010).

The present study mainly focuses to study the water quality of Attaabad Lake.

MATERIALS AND METHODS

The study area focused from the devastated site at Attaabad over the Hunza River valley to Hussaini village at the north of Hunza Lake. The study area included Attaabad, Shishkit, Gulmit and Hussaini villages of Gojal. During the study 20 samples were taken from Attaabad lake during the month of May, 2011.

All samples were grab taken at different locations as mentioned in Fig.1. The samples were analyzed for pH, alkalinity, biochemical oxygen demand (BOD_5), chloride, dissolved oxygen (DO), hardness as $CaCO_3$, sulphate and turbidity (NTU). pH and DO was determined on site. While the remaining parameters were determined in the laboratories of Institute of Environmental Studies, University of Karachi. The public health quality of water samples was determined using following parameters; total coliforms count (TCC), total faecal coliforms (TFC) and total faecal streptococci (TFS). The above mentioned parameters were analyzed by the methods described in Standard Methods for the Examination of Water and Wastewater (APHA, 1989) **.**

RESULTS AND DISCUSSION

The main source of water in Gilgit-Baltistan is the glacier and snowmelt, spring water. However, it is mainly used for drinking water in Gojal. The distribution of water is through the man-made channels that bring water into the settlements for agriculture, livestock and domestic requirements. The water normally available for drinking is not absolutely safe and normally contaminated with human and animal wastes. In the study area water borne diseases are common.

The public health quality of Attaabad lake water was determined through microbiological and chemical analysis. In all 20 water samples were collected from the entire stretch of the Lake from Hussaini to spill way of the lake. The results are reported in Table 1-2.

Quality of water collected for the present study from different location along the lake has been was found to be satisfactory and apparently poses no serious health hazard upon consumption. This may be due to the fact that the temperature of water is fairly low where the survival of organisms of public health importance seems to be difficult.

The protection of water sources as in present case is of prime importance in the provision of safe drinking water to the downstream communities. It is always better to protect water from contamination than to treat it after it has been contaminated. Protection of surface water is however, a problem, if water supplies are to remain potable, both the source and the catchments need protection. For this purpose, the lake should be protected from contamination due to anthropogenic activities.

Table 1. Water quality analysis (chemical) of Attaabad Lake.

Sample code	Coordinates	pH	Turbidity NTU	TSS mg/l	Chloride mg/l	Hardness as $CaCO_3$ mg/l	Alkalinity mg/l	Sulphate mg/l	DO mg/l	BOD_5 mg/l
LS-1	36 22 43 N 74 52 04 E	6.5	41.9	70	96	142	130	81	4.3	10
LS-2	36 22 16 N 74 51 48 E	6.4	32.1	71	98	135	125	83	4.3	Nil
LS-3	36 21 45 N 74 51 33 E	6.4	30.6	68	98	147	127	80	4.3	Nil
LS-4	36 21 25 N 74 51 29 E	6.4	35.2	65	91	131	121	85	4.1	Nil
LS-5	36 21 03 N 74 51 38 E	6.3	37.3	61	97	138	131	84	4.3	Nil
LS-6	36 20 47 N 74 51 51 E	6.4	23.3	62	88	139	120	89	4.2	Nil
LS-7	36 20 22 N 74 51 57 E	6.2	26.9	64	101	141	111	77	4.1	Nil
LS-8	36 20 05 N 74 52 05 E	6.3	30.0	58	92	147	123	75	4.5	Nil
LS-9	36 19 47 N 74 52 15 E	6.3	26.2	51	83	111	110	80	4.2	Nil
LS-10	36 19 37 N 74 52 19 E	6.3	25.2	50	96	120	137	71	4.2	Nil
LS-11	36 19 23 N 74 52 19 E	6.5	41.9	70	96	142	130	81	4.3	10
LS-12	36 19 13 N 74 52 06 E	6.4	32.1	71	98	135	125	83	4.3	Nil
LS-13	36 19 04 N 74 51 39 E	6.4	30.6	68	98	147	127	80	4.3	Nil
LS-14	36 18 53 N 74 51 17 E	6.4	35.2	65	91	131	121	85	4.1	Nil
LS-15	36 18 42 N 74 51 17 E	6.3	37.3	61	97	138	131	84	4.3	Nil
LS-16	36 18 22 N 74 50 24 E	6.4	23.3	62	88	139	120	89	4.2	Nil
LS-17	36 18 19 N 74 50 16 E	6.2	26.9	64	101	141	111	77	4.1	Nil
LS-18	36 18 9 N 74 50 5 E	6.3	30.0	58	92	147	123	75	4.5	Nil
LS-19	36 18 20 N 74 49 41 E	6.3	26.2	51	83	111	110	80	4.2	Nil
LS-20	36 18 22 N 74 49 25 E	6.3	25.2	50	96	120	137	71	4.2	Nil
Average		6.3	18.61	33.07	48.30	65.66	123.50	80.50	4.2	10

Fig. 1. Sampling points at Attaabad lake.

Table 2. Water quality analysis (Microbiology) of Attaabad Lake.

S.No	Sample No.	Coordinates	MPN/100 ml			Remarks	WHO Guidelines (1996)
			Total coliforms count	Total faecal coliforms	Total faecal streptocooci		
1.	LS-1	36 22 43 N 74 52 04 E	<3	<3	<3	Fit for human consumption	<3
2.	LS-2	36 22 16 N 74 51 48 E	<3	<3	<3	Fit for human consumption	<3
3.	LS-3	36 21 45 N 74 51 33 E	<3	<3	<3	Fit for human consumption	<3
4.	LS-4	36 21 25 N 74 51 29 E	<3	<3	<3	Fit for human consumption	<3
5.	LS-5	36 21 03 N 74 51 38 E	<3	<3	<3	Fit for human consumption	<3
6.	LS-6	36 20 47 N 74 51 51 E	<3	<3	<3	Fit for human consumption	<3
7.	LS-7	36 20 22 N 74 51 57 E	<3	<3	<3	Fit for human consumption	<3
8.	LS-8	36 20 05 N 74 52 05 E	<3	<3	<3	Fit for human consumption	<3
9.	LS-9	36 19 47 N 74 52 15 E	<3	<3	<3	Fit for human consumption	<3
10.	LS-10	36 19 37 N 74 52 19 E	<3	<3	<3	Fit for human consumption	<3
11.	LS-11	36 19 23 N 74 52 19 E	<3	<3	<3	Fit for human consumption	<3
12.	LS-12	36 19 13 N 74 52 06 E	<3	<3	<3	Fit for human consumption	<3
13.	LS-13	36 19 04 N 74 51 39 E	<3	<3	<3	Fit for human consumption	<3
14.	LS-14	36 18 53 N 74 51 17 E	<3	<3	<3	Fit for human consumption	<3
15.	LS-15	36 18 42 N 74 51 17 E	<3	<3	<3	Fit for human consumption	<3
16.	LS-16	36 18 22 N 74 50 24 E	<3	<3	<3	Fit for human consumption	<3
17.	LS-17	36 18 19 N 74 50 16 E	<3	<3	<3	Fit for human consumption	<3
18.	LS-18	36 18 9 N 74 50 5 E	<3	<3	<3	Fit for human consumption	<3
19.	LS-19	36 18 20 N 74 49 41 E	<3	<3	<3	Fit for human consumption	<3
20.	LS-20	36 18 22 N 74 49 25 E	<3	<3	<3	Fit for human consumption	<3

Conclusions

The study reveals that the water quality of Attaabad Lake meets the WHO guide lines (1996). However, it is anticipated that from the view point of quality and quantity the lake may face, critical problems arising from the following causes.

i. There is insignificant rainfall through out the year and therefore effective recharge is only thorough glaciers and snow melting.
ii. Water may be polluted with the organisms of public health importance due to indiscriminate discharge of untreated wastewater.
iii. So far no protection measures have been adopted to protect the reservoir from contamination from external sources.

The study envisages that quality of water is fit for human consumption. This conclusion is based on the very limited number of samples, therefore, it is suggested to carry out more extensive survey so as to identify the sources of pollution and to suggest mitigation measures.

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