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Physico-Chemical and bacteriological, Environmental Study of District Muzaffarabad after Earthquake 2005: A Case Study

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Abstract: The present study was carried out in Muzaffarabad District, where a magnitude of 7.6 earthquakes hit the Himalayan region of northern Pakistan and Kashmir in 2005.The epicenter of seismic tremor was found in the region of 19 km north upper east of the city of Muzaffarabad, the capital of Azad Jammu Kashmir. The earthquake, along with immeasurable human loss, changed socio-economic, demographic and environmental conditions in the area. Present study was conducted in 2015 to compare the pre and post-earthquake water quality of the area. A significant change was observed in pH, TDS and E.coliafter earthquake. pH, TDS and E.coli were found increased as compared to pre earthquake data.

The water was found polluted and unfit for drinking due to microbial contamination. Damaged building materials and debris of earthquake 2005 was found lying in rivers. There was no proper sewerage system .It is recommended that the best environmental protection policies should be made with the integration of all the departments in order to avoid gaps, overlaps and inefficiencies.

Keywords: Earthquake, Environmental protection, Environmental impacts, Water pollution, Biological contamination

1. INTRODUCTION

Muzaffarabad has an extensive region with an aggregate zone of 6117 sq.km. The population according Census1998 was 453957.Region was the most exceedingly terrible influenced environment of Kashmir in the seismic tremor as far as human losses and demolition of physical infrastructure (Halvorson *et al.* 2010). On October 8, 2005, at 8:50 a.m. local time, a magnitude M_w=7.6 earth-quake hit the Himalayan region of northern Pakistan and Kashmir (Hussain *et al.* 2009). The epicenter of seismic tremor was found in the region of 19 km north upper east of the city of Muzaffarabad which is the capital of Azad Jammu Kashmir (Durrani *et al.* 2005). Due to the 2005 earthquake, the District Muzaffarabad was adversely affected, 35,803 people lost their lives and 23,138were found injured. As indicated by government figures, 19,000 children died in the seismic tremor, the vast majority of them in far reaching crumples of school structures. The earthquake affected more than 500,000 families (Qasim *et al.* 2008).

The environment of the Muzaffarabad area was vulnerable before the earthquake comprises of fragile mountain ecosystems, significant long term impacts might be likely (Sidle *et al.* 2017). The earthquake had also resulted in adverse impacts on the environment. The impact on ecosystems was often less dramatic than structural damage, (Serva *et al.* 2016).

A detailed environmental assessment of the impacts of the earthquake was needed to quantify losses to forestry, aquatic and terrestrial ecosystems, including biodiversity, and to restore damaged ecosystems (Wang *et al.* 2012). Environment was intricately linked to the livelihoods of the affected communities because of their dependence on natural resources.Along with other so many environmental and social problems, the basic need based drinking water issue is also in question. Issues like lack of water treatment plants, improper sewerage system, absence of water filtering treatment plants, needs to be re-addressed.

Environmental and natural resource issues must therefore be basic components for government plans for reconstruction and recovery. While the country AJK had little control over the negative environmental impacts from the earthquake, it may take preventive environmental measures (Ali *et al.* 2009).

2. METHODOLOGY

2.1 Study area

District Muzaffarabadis situated at latitude of 34,3667 (3422'0.120”N) and longitude is 73, 4667 (7328'0.120"E) and altitude is 737 m.The city is placed in a tallness of 2,250 feet over ocean level may be a visitor delight. It may be arranged to a delightful rich valley that is bounded by forest covered mountains.

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Fig.1: Satellite image Pre 2005 earthquake

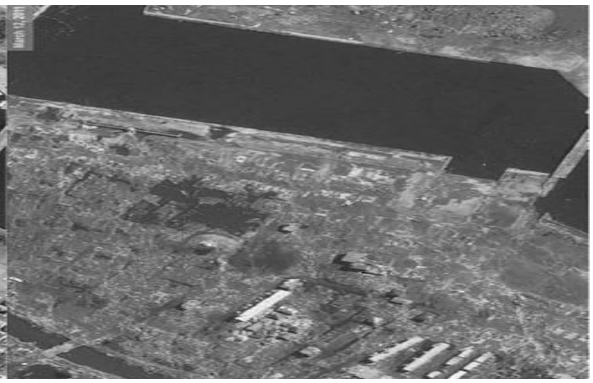

Fig. 2: Satellite image Post 2005 earthquake

Fig. 3: Image Post Earthquake in 2015

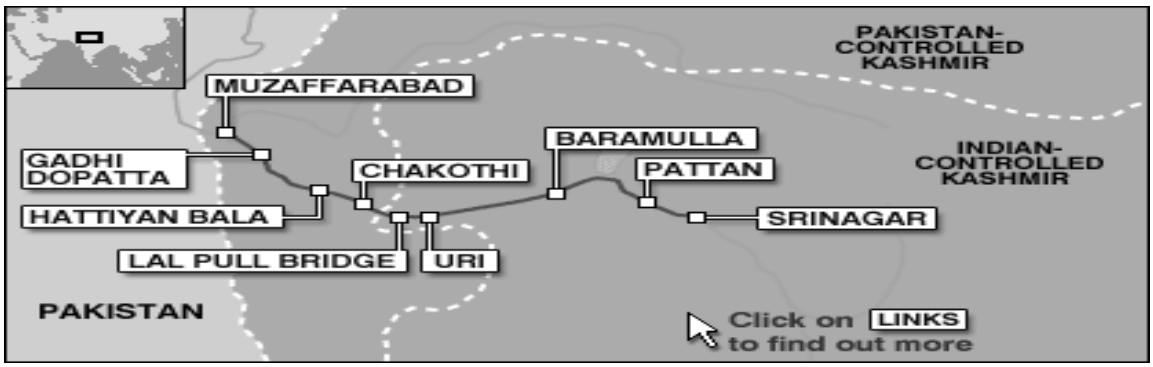

Fig. 4: Map of the study area District Muzaffarabad

2.1 Chemical analysis

The aim of the present study was to compare the water quality of District Muzaffarabad before and after 2005 Earthquake. Total nine (9) drinking water samples were collected from different places of springs and rivers after passing ten year of earthquake. During sample collection, proper standardized procedure and precautions were taken. Samples were than analyzed at EPA lab of Muzaffarabad. The pH of the water sample was measured with a pH meter model PHS-3C. The TDS of samples of the drinking water were measured by gravimetric method. For the microbial contamination in drinking water quality, membrane filtration method was used.

3. RESULT AND DISCUSSIONS

pH

The pH of water was totally changed after the 2005 earthquake in the Pumping station and Distribution reservoir at Chatter, Neelum River at Intake of WTP, Spring outlet at Dumail near service station, Distribution Reservoir at M-Ghulshan Colony, as these samples were near acidic in nature due to the debris and waste generated after the earthquake were freely thrown in the river water which badly affected the quality of the distributed water. pHwas found within range of 5.7 to 7.8 as shown in table 2. It is observed that during 2004 pre-earthquake, pH was 6.3 to 7.5 as shown in **(Table 1)** reported by Water Quality Monitoring (AJK).

Table 1 showing pre earthquake data in 2004 as reported by Water Quality Monitoring (AJK).

No	Sampling point	Location	Ph	TDS mg /L	E.coli / *100ml*
1	Spring outlet	Sthra under bridge	7.0	334	0
2	Spring outlet	Near Agriculture Research Centre	7.0	301	4
3	Spring outlet	Near AJK Taxation Council	7.0	368	43
4	Spring outlet	Army Camp	7.3	327	0
5	Spring outlet	Dumail near service station	7.4	398	0
6	Neelum River	Intake of WTP	7.5	97.1	21
7	Outlet of WTP	WTP	7.3	94.3	0
8	Distribution Reservoir	M-Ghulshan Colony	7.0	95.3	0
9	Pumping station *and*Distribution reservoir	Chatter	6.3	95	0

Table 2. Physiochemical and Bacteriological Water Qualities Analysis in 2015 Muzaffarabad

S.	Sampling point	Location	pH	TDS mg/l	E.coli */100ml*
1	Spring outlet	Sthra under bridge	7.2	340	7
2	Spring outlet	Near Agriculture Research Centre	7.1	321	6
3	Spring outlet	Near AJK Taxation Council	7.3	380	50
4	Spring outlet	Army Camp	7.1	340	5
5	Spring outlet	Dumail near service station	5.7	410	113
6	Neelum River	Intake of WTP	7.6	120	30
7	Outlet of WTP	WTP	7.4	111	88
8	Distribution Reservoir	M-Ghulshan Colony	7.8	105	9
9	Pumping station *and* Distribution reservoir	Chatter	6.2	103	6
	WHO	----	6.5- 8.5	1000 g/l	Nil
	NEQS Pakistan	----	6.5-8.5	1000 mg/l	Nil

TDS

The TDS in water samples of the study area was ranging from 111 to 410 mg/L. The analysis of the data concluded that the higher amount of TDS in spring outlet at Dumail near service station and spring outlet at Sthra under bridge was in high quantity due to the high number of Land sliding occurred in the area and were blocked in the river water. Though values of TDS were found within permissible limitsof WHO for drinking but water gave bitter taste as shown in **(Table 2)**. It was observed that TDS during 2004 pre- earthquake 94.3-398 mg/L as shown in table 1, reported by Water Quality Monitoring (AJK).

E.coli

The amount of E.coli was found within range of 5 to 113 /100ml.It was observed that municipal and domestic liquid waste is being thrown into rivers. Animal farm wastes were also seen disposed into rivers. All water samples were unfit for drinking due to presence of E.coli.It was observed that E.coli during 2004 pre- earthquake was in the range of 4-43 /100 ml as shown in table 1,reported by Water Quality Monitoring (AJK).

Fig.5 Debris affects the quality of water

The fundamental explanation behind the adjustment in ph was expected Municipal water supplied to Muzaffarabad originated from the River Jhelum. The waterway water was lifted from six admission lines and treated in a progression of quick sand channels and clarifiers. Harmed to this water framework ran from harmed to clarifier confounds, engine control units, and dispersion funneling in zones. After passing ten years of earthquake, proper filtering unit was not established due to lack of fund.

4. CONCLUSION

From the study examine the pre- post-earthquake impacts on the environmental parameters in District Muzaffarabad. After checking the quality of water by

sampling observed that it was a big hazard which people of Muzaffarabad faced at that time. There was no sewage system or water treatment plant and all waste which was generated due to collapsed buildings and other sewerage and domestic waste was directly fall in river which affects the quality of water. There were significant change occurred examined by sampling after earthquake in pH, TDS and E.coli which were about .00, .001and .033,made water unfit for drinking at some places .But still in 2015 it was observed that there was no proper sewerage system, all waste directly thrown in river water sources.

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To maintain the water quality, all spring sources should be protected.Water treatment plant should be installed and water monitoring systems should monitor the water quality on daily basis.

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