Evaluation of Water Quality Assessment and its Bearings on the Residents of Sindh RiverAlong Great Himalayan Region, J&K-India

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ABSTRACT *The present study was carried out to assess the water quality of river Sind and its impact on human health. Various physical and chemical parameters were taking into consideration in order to assess the quality measures as feasible according to World Health Organization (WHO)& Bureau of Indian Standards (BIS) norms. Water samples were collected at four different sites. After analyzing the water quality tests in center of research for development (CORD), University of Kashmir Srinagar,high contamination were found at sites III & IV which were located away from the source of river. Similarly, high prevalence of waterborne diseases were also reported at these sites Duderhama having incidence rate of 389.4 per thousand population and Kangan (387.7 per thousand population), such as acute diarrheal, gastro enteric, enteric fever and dysentery, while as least cases were reported from the nearer sites such as Baltal having incidence rate of158.35 per thousand population and Gund 374.4per thousand population.*

Keywords: *Water quality, WHO, BIS, Anthropogenic pressure, Human Health*

Introduction:

There has been growing concern about the needs to protect the environment from various forms of pollution caused by growing population, industrialization and by modern agricultural methods (Hunt & Wilson 1986). Water and land based anthropogenic activities within the system and in the catchment including the release of nutrients, organic matter, toxic chemicals and waterborne pathogens have a negative effect on water quality. Outbreaks of water borne diseases continue to occur throughout the world but especially serious in developing countries (Jones et al. 2007).The valley of Kashmir has been bestowed with ample fresh water resources in the form of glaciers, lakes, springs, rivers/streams and groundwater. These water resources are used for irrigation, hydropower generation and recreational purposes(Cogley, 2009).Water and land based anthropogenic activities within the system and in the catchment including the release of nutrients, organic matter, toxic chemicals and water borne pathogens have a negative effect on water quality. Bacterial contamination in particular accelerates when human activities are augmented, jeopardizing the safe use of water for drinking and recreational purposes. Bacteria often play a vital role in determining the extent of pollution (Higgins & Burns 1975) and the presence of fecal coliform is considered as presumptive evidence of fecal pollution (Mara 1978). The density of coliformbacteria in water is a significant criterion of degree of pollution in aquatic ecosystems (Odum 1985). It is well established that a large number of infectious diseases are transmitted primarily through water supplies contaminated with human and animal excreta particularly feces(WHO 1993). The state of Jammu and Kashmir too has high prevalence of waterborne diseases as protective and potable drinking water is not available to all people. Geography of the area is one of the factors acting as an obstacle in providing the basic amenities including drinking water to all the areas.People on globe are under tremendous threat due to undesirable change in physical, chemical, and biological characteristics of air, water, and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. It is necessary that quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases.India is no exception to this global phenomenon and the state of Jammu and Kashmir in particular suffers from such types of diseases. It is in the back drop of this that the present study has been carried out on the water quality of River Sindh Nallah which provides water for drinking and other purposes for a large number of population in Kashmir valley

Data and Methodology:

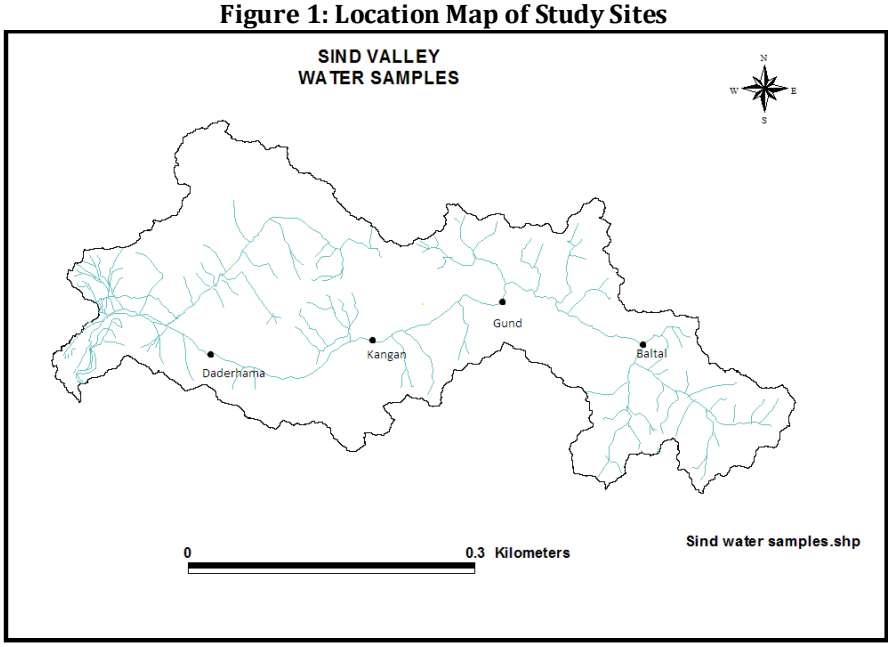
Water samples for quality assessment tests were collected at four different sites of river Sind and were tested at Center of Research for Development (CORD), University of Kashmir, Srinagar. Tested samples were related with WHO and BIS norms in order to see the deviation with the observed results. Secondary data

regarding different socio-economic variables, health status were collected from various published/unpublished records of Department of Health, Jammu and Kashmir, Sub districthospital, Ganderbal(J&K). Various Physical chemical parameters such as pH, Electric Conductivity, Total Dissolved Solids, Turbidity, Alkalinity,Hardness, Calcium, Magnesium and Chloride were gauged by using various methods such as titration method, pH strip meters, turbidity meter etc.

Study Area:

The Sindh River is a river in the Ganderbal district of Jammu and Kashmir state of India. It is the longest tributary of Veth (Jhelum) drains the highest part of Kashmir Himalayas. The Sind River forms the Sind Valley. The source of the river lies in Machoi Glacier at an elevation of 4800 meters, east of Amaranth temple south of Zojila pass. Sindh Valley is one of the largest side valley of Kashmir running from Panjtarni (a camping site of Amaranth yatra) southwards up to Domail where it joins a tributary which doubles its flow from Kolhoi Glacier. The Sind Valley is situated within the jurisdiction of Kangan tehsil, of Ganderbal district. It has a steep gradient of 1365m up to Gagangir, below which the slope is relatively gentle, with a drop in level of 729m(Kaul,2014). The River flows through the entire valley passing several natural landmarks, tourist spots including Baltal, the meadow of gold, Gagangir, Naranag and Wayil. The main towns in the valley are Gund, Mammer, Kangan, Wangath, Preng, Wussan and Manigam.The valley has been carved out by river Sindh in the extreme north-eastern part of the Kashmir valley and lies between the latitudes of 34^0 10/north to 34^0 28/ north, and longitudes of 74^0 40/ east to 75^0 25/east. The valley is bounded on three sides by Himalayan mountain ranges, which are side walls of three different sub-valleys of Kashmir namely Gurez, Zanskar and Lidder. Politically the Sindh Valley is bounded by Bandipur tehsil on the north, Sonawari tehsil in the west and pahalgam tehsil in the south-east.

Figure 1: Location Map of Study Sites



Source: SOI Toposheets 1971

Table 1: Sampling sites

S.No.	Site	Latitude	Longitude	Altitude (meters)
Site I	Baltal	$34^0$15/	$75^0$24/	2880
Site II	Gund	$34^0$14/	$75^0$5/	2097
Site III	Kangan	$34^0$17/	$75^0$12/	1810
Site IV	Duderhama	$34^0$12/	$74^0$45/	1584

Source: Compiled by Authors

Results

Table 2: Water Quality Assessment of Sind Nallah

Parameters	Units	Observed values				WHO	BIS
		Baltal	Gund	Kangan	Duderhama		
pH		8.2	8.2	8.9	9	8.5	8.5
Electric Conductivity	µs/cm	547	381	325	411	600	600
TDS	mg/l	390	270	230	535	500	500
Alkalinity	mg/l	86	82	212	235	200	200
Hardness	mg/l	86	73	69	60	200	300
Calcium	mg/l	59	50	46	40	200	200
Turbidity	mg/l	2.14	2.91	16.5	18.5	10	10
Magnesium	mg/l	27	23	24	20	50	150
Chloride	mg/l	35.45	38.28	45.37	51.04	250	250

Source:Aquatic lab Deptt.Of CORDUniversity of Kashmir, 2017
*TDS= Total Dissolved Solids

The table 2shows the water quality assessment of the Sind Nallah of four different sites Baltal, Gund, Kangan and Duderhama. The table shows the water quality of the Sind Nallah in the upper reaches (Site I & II)were feasible for drinking purposes. While in the lower reaches sitesIII &IV shows fluctuations in physiochemical parameters in certain physical and chemical parameters. The contamination is mainly due to presence of power house at Giraj which is on the tributary of Sind Nallah which joins Duderhama at Ganderbal.The other source of contamination is mainly due to anthropogenic activities such as dumping sites, water leakage from rusted pipes. Sewage & use of pesticides in horticulture practices in the lower reaches adding to the cause. Variation in pH, alkanity and turbidity were found at sites III & IV as per WHO and BISnorms.

Table 3: Sources of Drinking Water in the Study Area

District	Sites	Total Households	Tap water(%age)		Well Water (%age)	Other (%age)
			Treated	Untreated		
Ganderbal	Baltal (S1)	683	200 (14.3)	350 (24.4)	83 (25.6)	50 (22.1)
	Gund (S2)	1040	400 (28.5)	550 (37.9)	60 (18.5)	30 (13.2)
	Kangan (S3)	896	300 (21.4)	400 (27.5)	100 (30.8)	96 (42.4)
	Duderhama(S4)	781	500 (35.7)	150 (10.3)	81 (25)	50 (22.1)
Total	4	N=3400	1400 (41.1)	1450 (42.6)	324 (9.5)	226 (6.6)

Source: census 2011

The table 3 shows the sources of drinking water fetched by the residents. Out of 3400 households of the study area 41.1 percent were assessed with treated tap water, 42.6 percent of the households were supplied with untreated tap water, 9.5 percent with well water and 6.6 percent were fetched water from other sources such as streams.

Fig. 2:

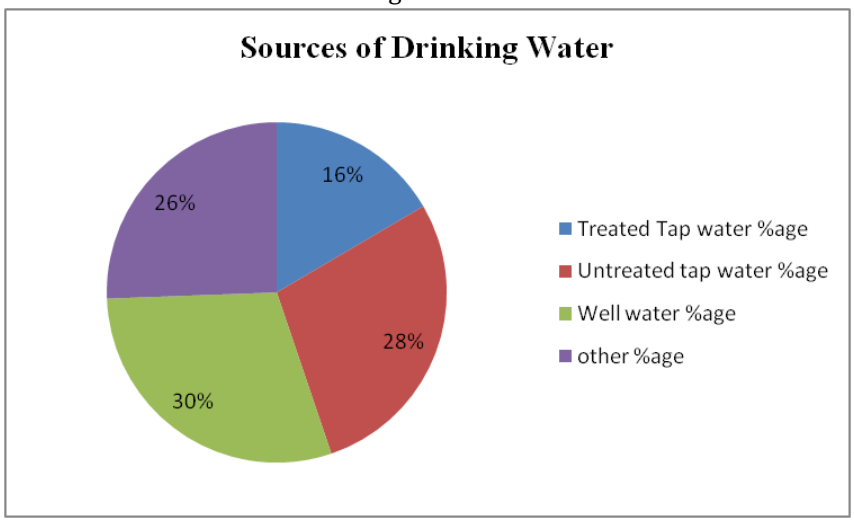


Table 4: Prevalence of Water Borne Diseases in District Ganderbal (2016 - 2017)

Sites	Villages	Total Population	Incidence rate of Waterborne Diseases/1000 population				Total incidence rate/1000 population
			Acute Diarrheal Disease	Gastro Entrites	Enteric Fever	Dysentery	
S1	Nilgirar	1085	200 (59.75)	150 (44.81)	100 (29.87)	80 -23.9	530 -158.35
(Baltal)	Sonmarg	1051					
	Sarbal	581					
	Shulkuri	630					
Total		3347					
S2	Sarf Raw	2042	350 (123.6)	300 (105.9)	220 -77.7	190 -67.1	1060 (374.4)
(Gund)							
	Chiner	1007					
	Kolan	842					
	Rayil	982					
Total		2831					
S3	Hayan Palpora	1260	1600 (123.6)	1200 (95.3)	1090 (86.5)	990 (78.6)	4880 (387.7)
(Kangan)	Khanan	658					
	Wangat	6616					
	Akhal	4053					
Total		12587					
S4	Wasun	940	1550 (121.7)	1345 (105.6)	1051 (82.5)	1011 (79.4)	4957 (389.4)
(Duderhama)	Manigam	7606					
	Borsoo	2102					
	Behama	2079					

Total		12727					
		31492	3700 (117.4)	2995 (95.1)	2461 (78.1)	2271 (72.1)	11427 (362.8)

Source: Sub district hospital Ganderbal, Census 2011

The table 4 shows the incidence of waterborne diseases at 4 selected sites of the study area. The table shows the overall incidence rate of waterborne diseases of all the sites in the year 2017 is362.8 per 1000 population, out of which site III & Site IV shows the high incidence rate i.e. 387.3per 1000 & 389.4 per 1000 population as compared to Site I and Site II which shows the low incidence rate i.e. 158.35 and 374.4 per 1000 population. The highest cases of incidence rate were from acute diarrheal disease contributing about 117.4 per thousand populations followed by Gastro Entrites about 95.1 per thousand populations inthe year 2016-2017. Incidence rate and spatial pattern of waterborne diseases shown in fig. 4& fig. 5.

Fig. 4

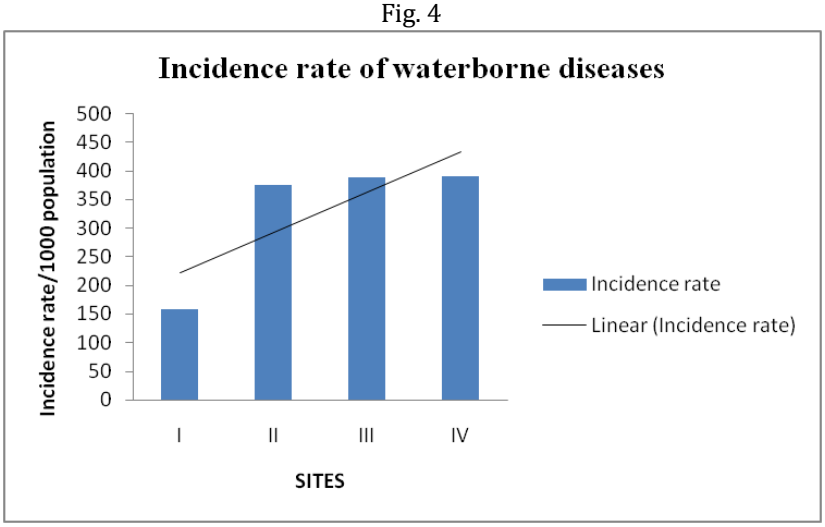
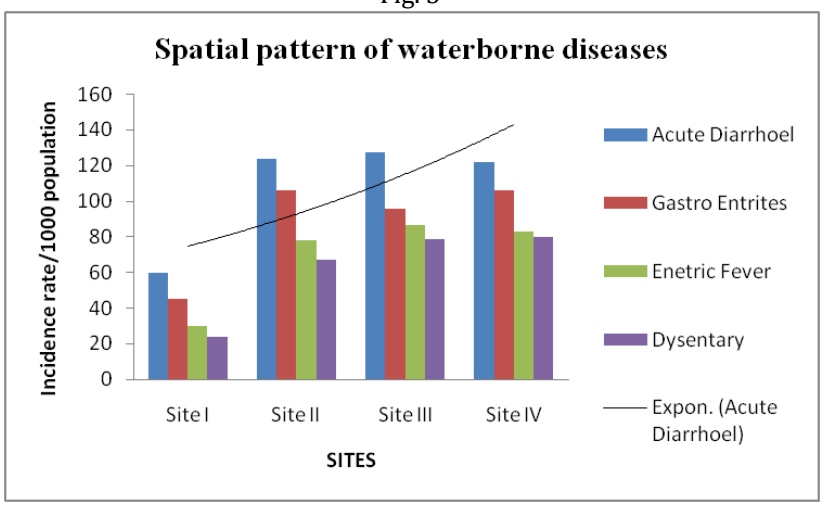


Fig. 5



Conclusion

Study was carried to appraise the water quality of Sind Nallah at different sites like Duderhama (Site-4),Kangan (site-3),Gund (site-2),and Baltal (site-1). The study shows the fluctuation of water parameters at few sites set by the WHO & BIS for drinking purposes and their impact on human health was found during the study. During the study it was found that there is an inadequate supply of potable water in the Ganderbal district as whole 41 percent of total households were provided treated potable drinking water while as the remaining 59 percent of households were forced to fetch water for untreated sources which makes them susceptible to different waterborne disease. In the study high contamination of water were found at the sites III & Site IV which are located away from the source region of river Sindh. The study also reveals the high incidence of waterborne diseases at Site III and IV i.e. 387.3 and 389.4 per thousand

population as compared to site I and II which shows the decrease incidence rate of 158.35 and 374.4 per thousand population which clearly indicates that deteriorated quality of water at sites III and IV being far away from the source region and is highly polluted by anthropogenic factors. In regard of the study carried at Sindh river following recommendations has been put forward in order to lessen the burden of waterborne diseases. Government must accelerate water protection laws by encouraging the protection of water bodies & water resources in the study area. Regular water testing is necessary to determine specific water quality problems. The study further suggests that access to basic amenities should be facilitated to the local people of the study area for safeguarding their human health and reducing their vulnerability risk. Last but not least, arrangements should be made to organize seminars, workshops and awareness campaign drives at village level regarding sanitation and hygiene environment of the study area.

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