FIELD VISIT REPORT OF WATER SUPPLY COMPLEXES

Team Members:

1. **Usama Rehmat** — **Scientific Officer(EIA/Legal)**
2. **Syed Jarrar Hussain** — **Scientific Officer (Lab/R&D)**
3. **Syed Waqar Hussain** — **Field Monitoring Assistant**

Dated: Monday- December 24th, 2018

On the directives of Chief Secretary Gilgit-Baltistan, GB-EPA team visited Barmus and Jutial Water Supply Complexes on 24th December 2018 and carried out detailed investigation of said Water Supply Complexes.

Policy Context:

National Drinking Water Policy of Pakistan states that the Government of Pakistan, while recognizing that access to safe drinking water is the basic human right of every citizen and that is the responsibility of state to ensure its provision to all citizens.

Definition of safe drinking water stated in the policy is "water complying to National Drinking Water Quality Standards of Pakistan". Access means that at least 45 and 120 liters per capita per day of drinking water is available to rural and urban area respectively.

Survey Methodology

To assess the drinking water quality situation in Barmus and Jutial Water Supply Complexes (WSC), EPA investigation the issue using following;

1. Microbiological and physiochemical analysis of drinking water from the storage tanks and transmission pipes.
2. Physical parameters test of water storage system.
3. Sanitary inspection of intake system, storage tanks and distribution network.
4. Chemical parameters tests of water supply systems

GB-EPA team has conducted detailed water quality testing in accordance with World Health Organization (WHO) Guidelines and National Drinking Water Quality Standards (NDWQS) of Pakistan. The survey has been designed as:

- Sampling selection technique, ***Random Sampling was adopted.***
- Sampling conducted in accordance with "Sampling Procedure Rules 2005" notified by Government of Pakistan.
- Membrane filtration technique has been adopted for microbiological contamination (recommended by US-EPA).
- For Chemical contamination, Voltammetry and Photometry technique was adopted (recommended by US-EPA).
  Results are prepared in accordance with (NDWQS) and WHO Guidelines and Criteria for Drinking Water Quality.

1. Microbiological Analysis;

Using WEGTECH water-testing kit carried out microbiological test. Eight samples were collected from water supply tanks and transmission pipes at different locations.
The summary of test results are as under;

S.No	Sample Location	No. of Colonies count (E Coli)	National Drinking Water Quality Standard	Water Quality
1	Barmus WSC Inlet	Nil		Fit
2	Barmus WSC Outlet	Nil		Fit
3	Fateh Bagh Tap	Nil		Fit
4	Kashrote Tap	Nil	**Zero Col/100 ml**	Fit
5	Jutial WSC Inlet	Nil		Fit
6	Jutial WSC Outlet	Nil		Fit
7	FCNA tap	Nil		Fit
8	Khomer Tap	Nil		Fit

***WSC Water Supply Complex**

Remarks

All the samples tested were found within the permissible limits set by WHO and NDWQS regarding bacteriological contamination. In winters the possibility of bacteriological contamination is minimal due to freezing or low temperature, as temperature exerts a major influence on biological activity and growth of microorganisms. Moreover, the anthropogenic activities (Grazing and agricultural activities) within the catchment area of source water are limited due to harsh climatic conditions upstream. Biological contamination is a function of season, it reduces to zero in winters and increase on the onset of spring and reaches maximum in summers.

2. Physical parameters test of water storage system.

Physical parameters like pH, turbidity, total dissolved solids (TDS), color, odor and taste were tested on the spot using digital pH meter, turbidity measuring tube and TDS meter. Color, odor and taste were physically observed.
The results depict all the physical parameters within the permissible limits of National Drinking Water Quality Standards.

S. No	Sample Location	PH	Turbidity	TDS	Color	Odor	Taste	Water Quality
1	Barmus WSC	8.2	<5 NTU	274 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
2	Barmus WSC	8.1	<5 NTU	261 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
3	Fateh Bagh Tap	8.1	<5 NTU	251 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
4	Kashrote Tap	8.1	<5 NTU	260 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
5	Jutial WSC Inlet	8.0	<5 NTU	324 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
6	Jutial WSC Outlet	8.0	<5 NTU	301 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
7	FCNA tap	8.0	<5 NTU	280 ppm	No Objectionable	No Objectionable	No Objectionable	Fit

8	Khomer Tap	8.0	<5 NTU	289 ppm	No Objectionable	No Objectionable	No Objectionable	Fit
***NDWQS**	**pH**	**6.5-8.5**		**Turbidity**	**<5NTU**	**TDS**	**<1000 ppm**	

Remarks

All samples tested for pH, turbidity, Total Dissolved Solids, Color and Odor are within limits of National Drinking Water Quality Standards and WHO Guidelines. During winters soil and sediment load decreases due to less hydraulic pressure (soil erosion) on the slopes of catchment area, resultantly the concentration of physical parameters also remains within the permissible limits in the season thereof.

3. Sanitary inspection of intake system, storage tanks and distribution network.

Eutrophication is the process in which water receives nutrients (Nitrate, Phosphate and Potassium) and sediments due to which water become more fertile. The additional nutrients cause algal growth, which deteriorate the water quality and make it unfit for drinking purpose. During the investigation excess amount of algal growth was observed in the water storage tanks of Barmus Water Supply Complex while Jutial Water Supply Complex had a small concentration of algal growth.

Remarks

Human practices and agricultural runoff, discharge of grey, brown and black water from the settlements in catchment area and animal dung in grazing areas are main sources of nutrients which provide grounds for algal growth.

Sanitary Inspection of Intake System, Storage Tanks and Distribution Networks

Visual inspection of water supply complexes and their surroundings was examined to build a conclusion on the prevailing condition of water supply system. Physical inspection was carried out as per "WHO Guidelines, Volume 3, Surveillance and Control of Community Supplies". During inspection it was observed that the water storage tanks of Barmus Supply Complex were not properly fenced and covered, which provides easy access to stray dogs, rodents, flies and livestock to enter the premises and contaminate drinking water. Furthermore, animal and human feces were found adjacent to water storage tanks of Barmus Supply Complex posing threat to the health of populace. The sanitary condition of Jutial Water Storage Tanks were satisfactory however the sources of both water supply complexes were not protected; subjected to anthropogenic activities and livestock, posing adverse impacts on human health.

4. Chemical Parameters

From each sampling point, water samples were collected in cleaned plastic bottles rinsed with 20% diluted nitric acid and transported to GB-EPA Laboratory. GB-EPA procured equipment Metalyser HM2000 to test cadmium (Cd), lead (Pb), mercury (Hg), arsenic (As) and zinc (Zn) while Metalometer HM2000 was used to detect aluminium (Al), boron (B), iron (Fe), copper (Cu), manganese (Mn), chromium (Cr) and nickel (Ni) .

Continuous monitoring of drinking water quality is very essential in terms of toxic chemicals. Human gets exposed to heavy metals through inhalation and ingestion; long

lasting bioaccumulation and toxicity of heavy metals has demonstrated a great threat for human health and environment. The toxicity of metals to human depends on duration, concentration and route of exposure. Exposure to these metals can lead to diseases such as Muscular dystrophy, Parkinson's disease, Alzheimer's disease, Minimata disease and multiple sclerosis.

Sample taken from Barmas Water Supply Complex was found contaminated with Chromium (Cr), Nickel (Ni), and Zinc (Zn), however, the concentration of these metals were within the limits of NDWQS of Pakistan and WHO guidelines. Only Chromium (Cr) was found in the water sample taken from Jutial Water Supply Complex, however the concentration was found within the permissible limits.

Sr. No	Sample Location	Arsenic (As)	Mercury (Hg)	Copper (Cu)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Chromium (Cr)	Zinc (Zn)	Nickel (Ni)	Boron (B)
1	Barmus WSC	ND	ND	ND	ND	0.03	ND	0.03	ND	0.02	ND
2	Jutial WSC	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND

***NDWQS**	**As**	**≤0.05mg/l**	**Hg**	**≤0.001mg/l**	**Cu**	**≤2mg/l**	
	Ni	**≤0.02mg/l**	**ND**	**not detected**	**Mn**	**≤0.5mg/l**	
	Cr	**≤0.05mg/l**	**Zn**	**≤5mg/l**	**B**	**≤0.3mg/l**	

Remarks

Access to water is not an issue in GB, however quality of water remains always an issues in the region. Rapid population, economic growth, anthropogenic activities, lack of planning, capacities, and financial resources along with climate change are the fundamental factors for deterioration of surface drinking water sources in GB.

Surface water is the main source of water supply in urban areas of Gilgit-Baltistan. Problems associated with drinking water sources are highly dependent on the geological characteristics of the water catchment, anthropogenic activities around water catchment areas and seasonal variations. Many researchers have reported bacteriological contamination of surface water sources in GB. Turbidity in water sources, which is very high in summer seasons due to melting of glaciers and soil erosion, is reported in most surface water sources in GB. These high turbid sources of drinking water demands high tech water treatment techniques to produce clean water for application of advance water disinfection to make it safe for human consumption as per NDWQS.

Conclusion:

The inhabitants of Gilgit City are dependent on multiple sources of drinking water. Barmus and Jutial Water Supply Complexes are feeding central, southern and southeastern parts of the city. Existing intake structure, feeding pipes, water storage and treatment facility, and distribution system and management structure is decades old that can fulfill neither the quantity issues nor the quality. It is required to provide a

comprehensive water supply, storage, treatment and distribution system through engaging reputed consultants taking into account the quality, quantity and modern management structures. It is further concluded to conduct feasibility study for the integrated water supply system of Barmus and Jutial under a PC-II sponsored from block allocation in order to formulate a comprehensive PC-I based on scientific investigation of the issue and its management.

Recommendations

Water supply is a specialized subject of public health engineering being dealt in the region by conventional methods and practices. The fluctuations in quantity of water in streams reflect in quality also. Bacteriological contamination starts in March followed by turbidity in May. Unprotected source and uncovered water storage tanks aggravate the situation further.

In order to ensure safe drinking water to the inhabitants of Gilgit city, following measures are recommended;

i. As the bacteriological contamination and turbidity are function seasonal hydrological fluctuations in streams and anthropogenic activities upstream the intake system,
    a. Source protection is needed right from the intake system to avoid fecal contamination in the water,
    b. Resilient intake structure is needed in order to cater the need in lean period and during highest flows and also to withstand flooding conditions.

ii. Current water storage facility is insufficient that need expansion to double in size from the present-day requirements in order to provide capacity for storage and treatment.

iii. Since turbidity and bacteriological contamination start from March that need sequential treatment to remove turbidity first and make it fit for bacteriological treatment and removal. System design shall take into account the season, turbidity load, bacteriological concentration and the quantity of water required for the city.

iv. Onsite water quality testing facility is basic requirement of every water storage, treatment and supply system that also ensures level of treatment and proper dosing of chemicals required for treatment.

    Training of management staff and workers is required to properly operate, maintain and treatment of water in the water supply complex.

EXHIBIT

Poor/rudimentary infrastructure of water supply system, as overflowing water from upper tank gets its way into next tank accompanied with pollutants. Sanitary condition is very poor and algal growth can be seen.

Seepage /infiltration of overflowing water into water storage tank, possible source of contamination.

Animal and Human Feces adjacent to storage tanks.

Unprotected open source of Jutial Water Supply Complex

Storage of paints and other chemicals adjacent to water tank, possible source of chemical contamination.

Algal growth in storage tanks of Barmus Water Supply Complex

Inferior design of open intake system exposed to contamination.

Broken Values and pipes exposed to ingress of pollutants in water.