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Environmental Concerns for Water Consumption from Polluted Water Bodies in Watershed Area of Sindh Province

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Abstract

In the developing countries like Pakistan, the major source of water for drinking, agriculture and industries is the surface and groundwater. The main users of water are three sectors (e.g., domestic, agriculture and industries) that have not found proper disposal networks for untreated wastewater. The indiscriminate effluents from these areas are being discharged into water bodies and thereby, water becomes unfit for drinking and reuse. Furthermore, this contamination becomes detrimental to environment and creates serious health issues. The use of chemical and pesticides for crops is common practice and run-off from irrigated-agriculture finds its way into surface water bodies and seeps into ground water which also drains into water bodies, as resulting in water pollution, environmental concerns and adverse health problems. This paper presents adverse impact of the industrial, agricultural and raw sewage effluents disposal into Left Bank Outfall Drainage (LBOD) system in Sindh Province which blights the surface water bodies and groundwater quality. In Sindh province, 78% of ground water quality is brackish and or saline which is not fit for drinking and domestic use. However, the people are withdrawing it for drinking where facility of fresh surface water is not available and this phenomenon becomes major cause of diseases (i.e., hyper tension/ blood pressure, dysentery, cholera, typhoid, hepatitis etc.). The analyzed results of collected samples from drains and groundwater exhibit higher level of polluted water which is unfit for drinking and biotic life.

Keywords: Water bodies; Contaminated water; Disposal networks; LBOD system; Environmental concerns

Introduction

Water is one of the unique natural resources present in earth's surface and life cannot exist in absence of it. Although, there are plenty of water resources on earth, however, it is not always present with permissible quality and quantity. The availability of water for commercial and personal purposes is limited. Due to growing population the water bodies like rivers, streams, reservoirs and oceans are getting polluted after each day passing. The major cause of water pollution is the surrounding human and biological activities associated with pure water present in nature [1,2]. It is highly regarded that the basic duty of every person should be to conserve water resources so as the generation of waste water will be reduced [3,4]. Water is mainly obtained from two main sources (i.e., surface water and groundwater), which are constantly used in developing countries [5]. The pollution of water is one of the major problems in most of the areas of developing countries [6]. Therefore, unsafe drinking water is a foremost cause of deaths caused due to outbreak of endemic diarrheal disease each year [7]. It is estimated that, about 1.5 billion people have no access to safe drinking water worldwide and about 5 million deaths per year are attributed due to waterborne diseases [8]. Access to safe drinking water is a basic need for human health and development and, it is globally accepted human right [9].

The rapid expansion in growth of population with urbanization, development of industrial sector, dumping of solid wastes and lack of legal action has resulted in the degradation of water quality and quantity in developing countries like Pakistan [10]. During the previous decades, the water quality is deteriorating because of excessive use of fertilizers, pesticides and insecticides. The situation further gets deteriorated because of unchecked disposal of untreated municipal and industrial wastewater [11]. It is observed that around 120 different industrial discharges from untreated industries are directly released into Hudiara drain. It is worthy to mention that Hudiara drain is a trans-boundary water channel which originates from India and enters Pakistan territory [12]. Earlier, water use to be collected from storm water and it appeared as drain occasionally. However, these days it had turned from a prominent stream into a polluted wastewater drain due to indiscriminate discharge of untreated industrial effluents and sewage waste from both the countries [13-16]. Long term use of untreated wastewater for irrigation purposes, also resulted in a contamination of aquifer and soil profile that ultimately might appear as a potential risk to human health through food chain [17]. Common practices (e.g., frequently discharge municipal, agricultural and industrial wastewater) into water bodies further deteriorates environmental classes [18]. Furthermore, the use of the polluted water exposed due to biological and chemical contamination of water bodies in Sindh province is a common practice in rural areas. The major source of water pollution is industrial wastewater, municipal wastewater, seepage of fertilizers and pesticides from agricultural fields. Further, the seawater intrusion and highly toxic laden industrial effluents disposal into surface drains of the main drainage Left Bank Outfall Drain (LBOD) system, have directly affected on drinking water quality, aquatic life and soil [19]. In order to address water logging and salinity problem in the Left Bank of the Indus River, the LBOD was constructed for collecting drainage water

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from the three districts of Sukkur Barrage command area (Shaheed Benazirabad, Sanghar, and Mirpurkhas). Also, the drains leading to the sea through a Tidal Link drain was constructed as part of the LBOD project. However, there are many unresolved issues in the outfall area and coastal zone [20]. The Kotri surface drainage system was already constructed in 1960s for controlling this problem of water logging and salinity. Moreover, it was constructed with the intension for safe disposal of drainage water, heavy rainfall water through low lying area of Rann of Kash and wetlands [21]. The wastewater of domestic, agricultural and industrial is being discharged into drainage system through a network of LBOD system [22]. The generated effluents even leach into ground water forming undesired polluted pool which changes chemical property of groundwater [23]. It is estimated that around 70% of industrial wastes in developing countries are disposed untreated into waters where they contaminate existing water supplies [24]. As result in neglect of safe drinking water supplies, 2.5 million Pakistani children under age of five die every year with water borne diseases. Most common diseases include diarrhea, cholera, hepatitis and typhoid which are caused by untreated water [25]. The overall aim of the study is to determine the impacts of illegal and untreated discharge disposal (LBOD system) on the water quality.

Material and Methods

Research study area

The research study area covers the catchment area of LBOD system which was constructed during 1984-1997 to relieve water logging and salinity of 1.27 million acres' land in the areas of Mirpurkhas, Sanghar, and Nawabshah Districts (Figure 1). The problem of water logging and salinity in the agriculture lands of Sindh is being addressed through drainage and pumping of ground water. The area affected by water logging and salinity in Sindh include irrigated agricultural land of Sukkur and Kotri Command Area. Thus a main drain on the Left Bank of Indus River was constructed as a big national drainage project known as Left Bank Outfall Drain (LBOD). The area served by LBOD had acute problems of salinity and water logging which severely affected the productivity, income and livelihood of the population living in this area. The objective of the LBOD scheme was to relieve water logging by lowering the water table and remove saline water from this irrigated area.

Samples collection

The overall forty-three water samples were collected from different locations of watershed area of LBOD system (study area). This constitutes twenty-four locations of branch drains and nineteen locations of hand pumps (groundwater). The water samples were collected from drainage system and groundwater in draw season. This water is used for agriculture, livestock and aquatic life (fish and birds) and shallow water hand pumps for drinking purpose. The collected samples were analyzed for pH, EC, TDS, TSS and DO through pH meter, TDS/EC meter, DR 2000 Spectrophotometer and DO meter respectively. The analyzed results of different parameters of the collected samples are being described as under.

Results and Discussion

Results of all forty-three samples collected from different locations of Drains and Hand pumps were analyzed and the results of different parameters were brought under discussion. The pH measure is the determination of acidic or basic nature of water. The values of samples are between lower and upper permissible limits as per National Environmental Quality Standards (NEQS) (Figure 2) but the values of pH of two sub-drains 4AL and 3R drains are near to upper limit. These high levels of effluent flowing in sub-drains show the direct effluent

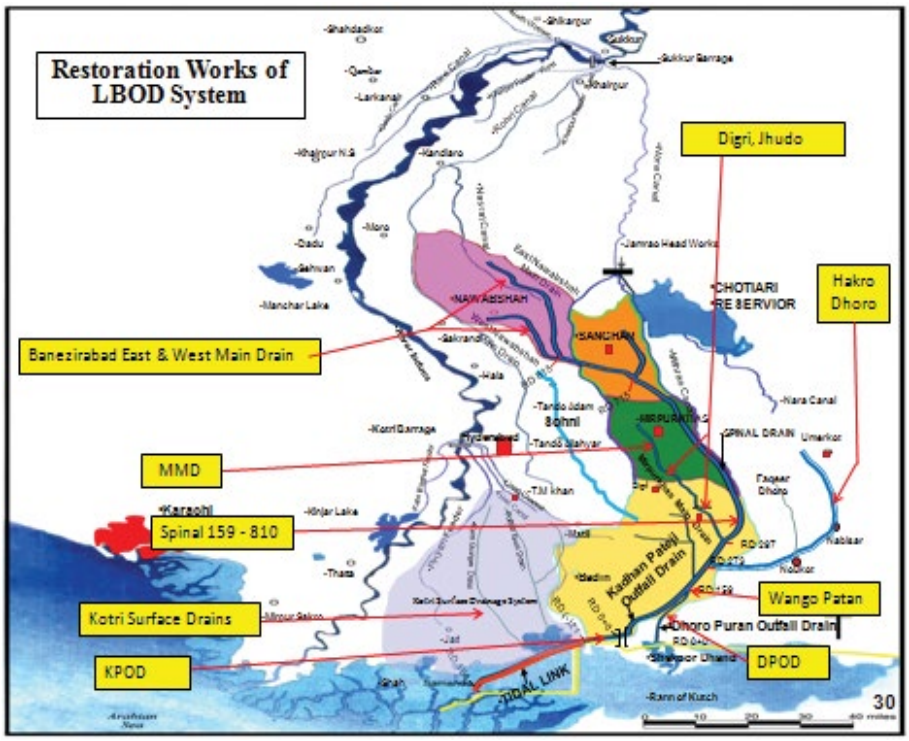

Figure 1: Research study area.

receiving from Sugar Mills. However, changing in pH (acidity and alkalinity) may induce harmful effects for biotic life and human health.

The pH values exhibit low intensity of alkalinity and/or acidity for water samples collected from hand pump (Figure 3). It was observed that fresh water is slightly alkaline due to presence of carbonates. The pH values of samples of groundwater are under lower and upper permissible limit. The rationale may be due to occasional rains.

Electrical Conductivity (EC) is ranging from 2000-9000 µm/cm (Figure 4). The EC value of G4R End-drain is highest in the comparison of collected samples from different drains. While EC of all collected samples from drains is higher to permissible limit of NEQS. Thus, indicates that drains water is unfit for drinking for livestock and dangerous to aquatic life.

It was observed that electrical conductivity of six water samples is

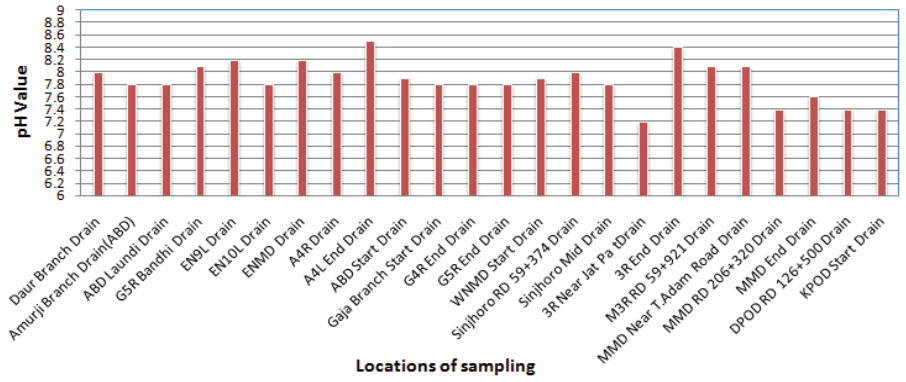

Figure 2: pH value of drains.

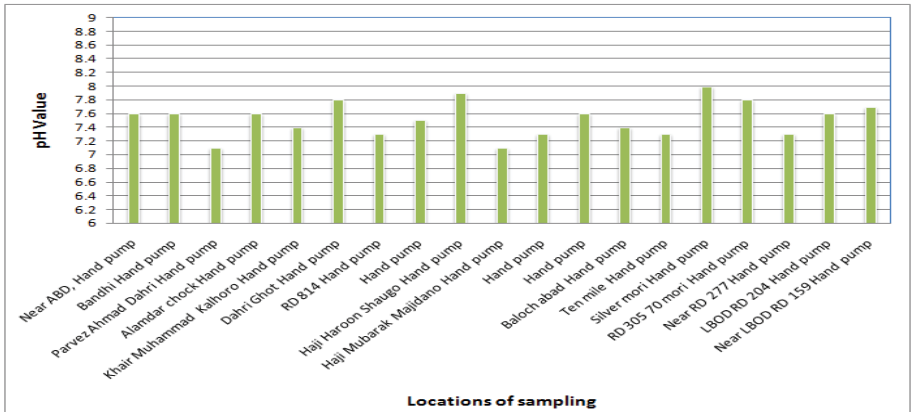

Figure 3: pH value of hand pump.

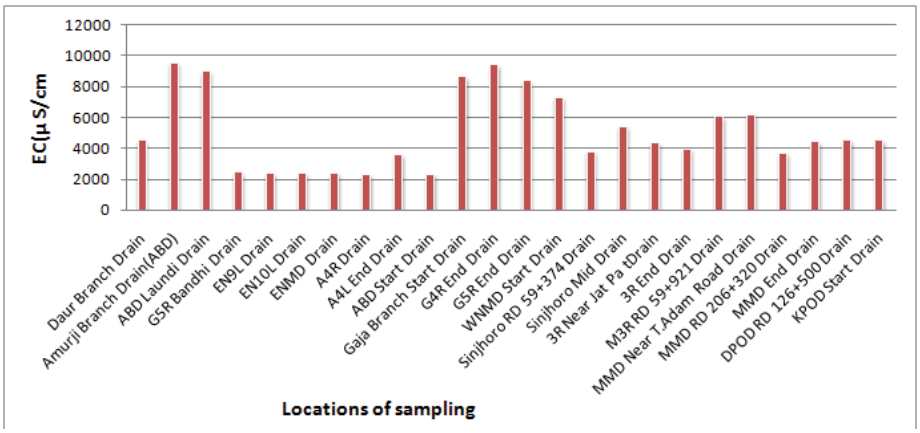

Figure 4: Electric conductivity of drains.

within the drinkable standards range out of nineteen samples collected from hand pumps and therefore water quality of 13 hand pumps is not fit for drinking purpose (Figure 5). Moreover, the electrical conductivity is lower at location of Silver Mori Hand pump and higher level at location Dahri Ghot Hand pump. It is worth to mention that the local population is drinking hand pumping water which is deleterious for human health.

The values of total dissolved solids (TDS) of the collected samples are ranging from 1000-6000 mg/L which is a big variation in water drains (Figure 6) and most of the values are higher than permissible limit recommended by NEQS. The TDS are correlated fairly well to the total mineral content of the water, primarily salts, carbonates and metals. A high concentration of the TDS is an indicator for possibly high levels of contamination. However, all drains have relatively higher

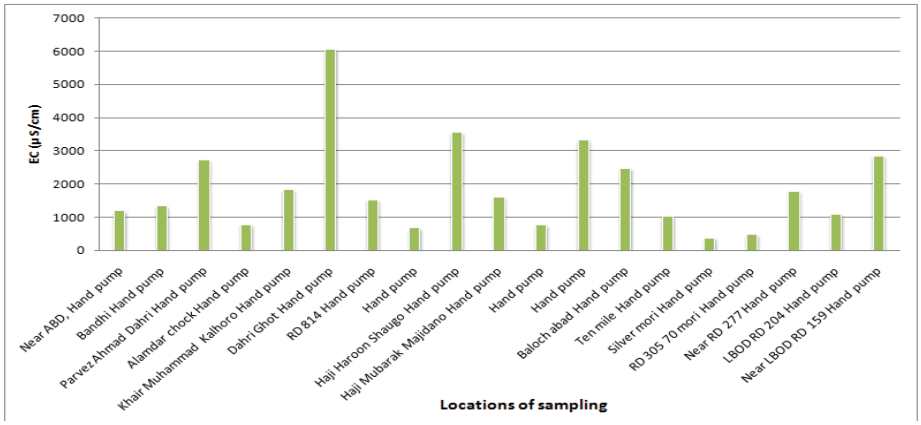

Figure 5: Electric conductivity of hand pumps.

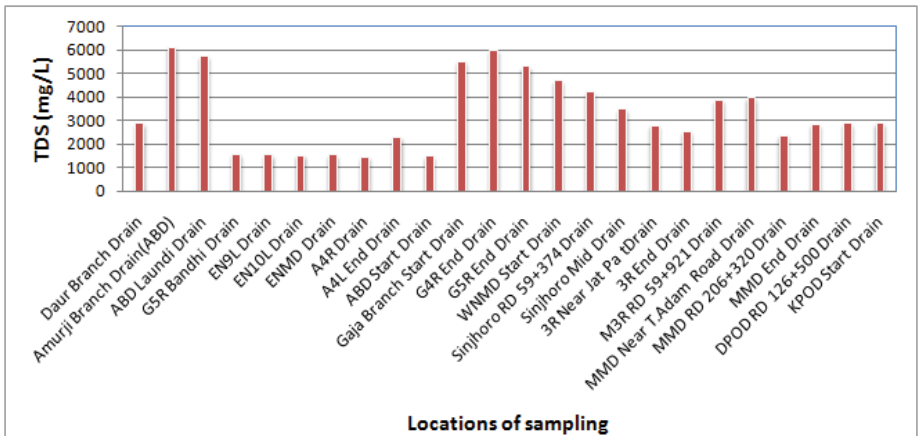

Figure 6: TDS of drains.

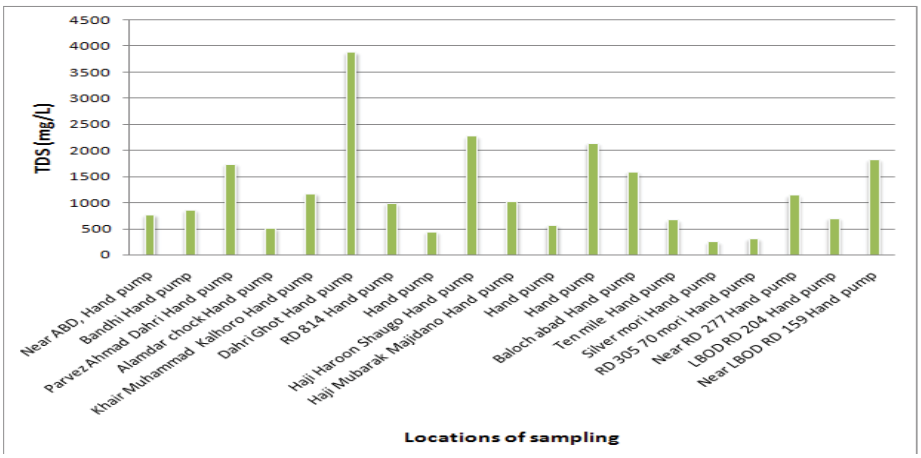

Figure 7: TDS of hand pumps.

the TDS value of (>1000 gm/L) but TDS levels can be lowered due to dilution storm water incoming from the catchment in to drainage system as has been observed during heavy rainfall in 2011.

The TDS values of the collected samples from different locations of hand pumps are ranging from 300-3800 mg/L which shows some variation in groundwater hand pumps (Figure 7).

Figure 8 indicates that values of TSS ranging from 0.25-3.5 mg/L. Total suspended solids (TSS) are bad odor settled to deposit slush in

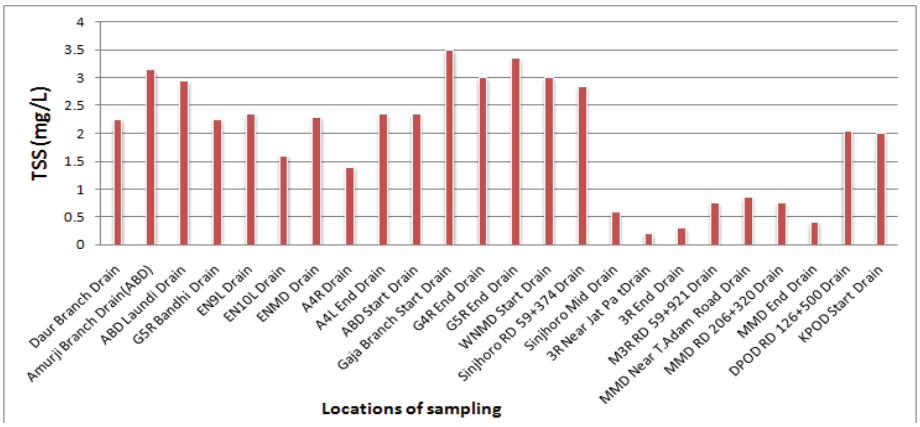

Figure 8: TSS of drains.

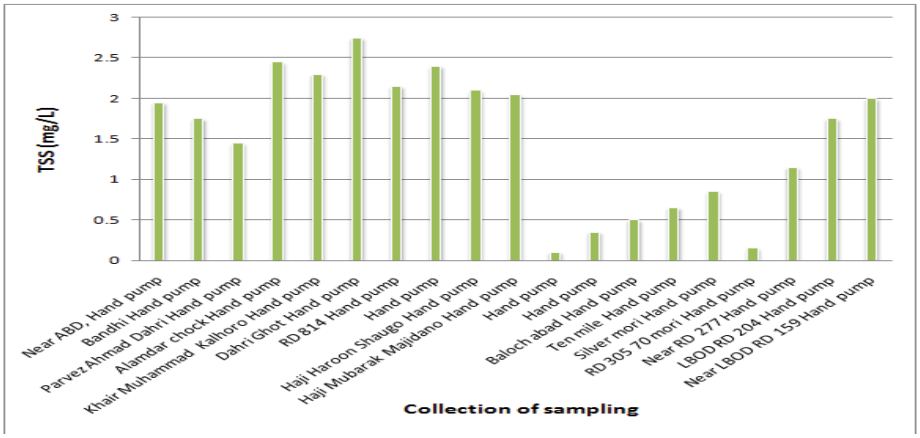

Figure 9: TSS of hand pumps.

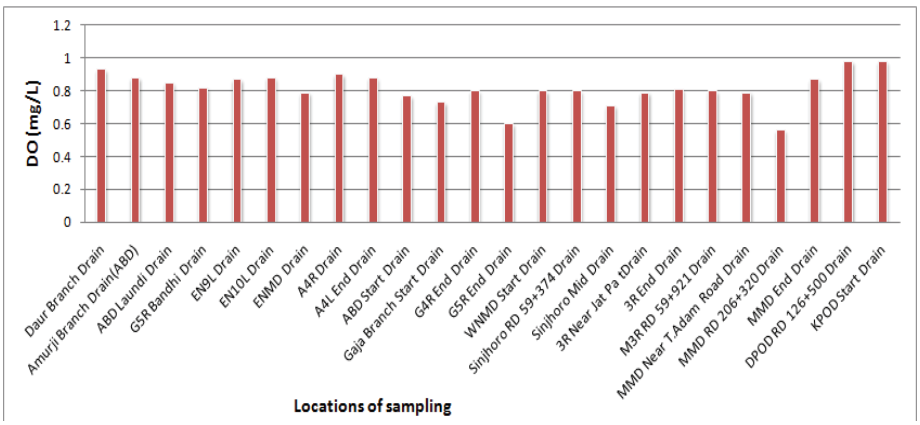

Figure 10: Dissolved oxygen of drains.

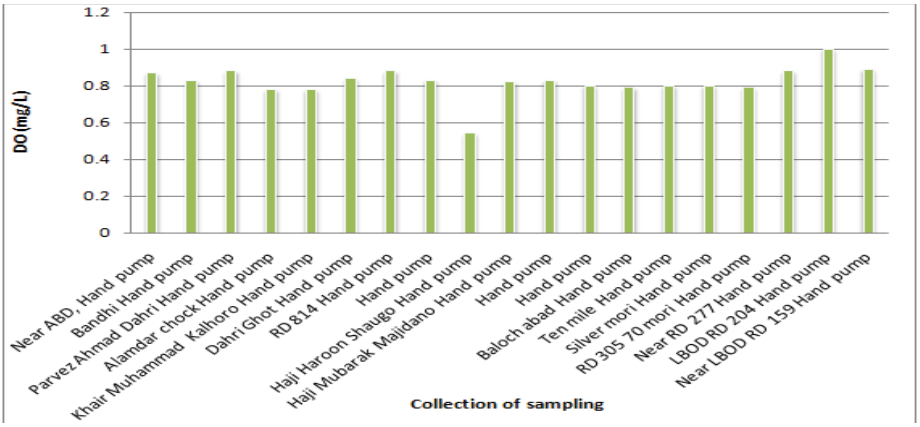

Figure 11: Dissolved oxygen of hand pumps.

water bodies these cover the bottom with material that can damage food for biotic life. Results indicate that TSS values of drains are within permissible NEQS limits.

It was observed that TSS values of groundwater hand pumps are ranging from 0.25-2.75 mg/L. In underground water, TSS form slush for depositing in screening pipes of hand pumps. Results show that TSS of hand pump samples are within permissible NEQS limits (Figure 9).

Dissolve Oxygen is one of most important parameters of water quality evaluation (i.e., index of physical, chemical and biological process in water bodies). The dissolved oxygen in wastewater and natural water bodies depends on chemical, biological and physical activities of water bodies. The aquatic life in water bodies rest on dissolved oxygen, bio-chemical changes. The guidelines value of dissolved oxygen in normal drinking water is 8 mg/L [26]. The samples collected from drains are not within permissible limit (Figure 10). These results demonstrate that there is low oxygen for aquatic life in water bodies which causes death of biotic life.

The dissolved oxygen of pumping groundwater is ranging from 0.5-1 mg/L (Figure 11). Dissolved oxygen is an indicative of oxygen depletion. Samples collected of groundwater from different locations were analyzed and their results reveal abnormal dissolved oxygen as per permissible NEQS limits.

Conclusions

The water from canals, natural ways and drains are highly contaminated owing to disposal of Sugar Mills/Industrial, domestic and agricultural effluents. The agro-chemicals, fertilizers and pesticides are used for enhancing crop yield which find their way into depressions. Thus, residents come under direct threat of polluted water of natural ways, drains, hand pumps and spinal drain. It has been concluded from results of collected samples that the pH and TSS values of drainage water are within permissible limit while values of EC and TDS shows 100% pollution of drainage water. The DO levels of all samples are lower than permissible limit. The pH and TSS values hand pump water is within permissible limit and the analyzed results indicate that EC and TDS of 58% samples have been found in poor quality and 42% within permissible limit. Therefore, hand pump water is not fit for drinking. The analyzed results of collected samples from drains, hand pumps demonstrate that the water quality is unsatisfactory and unfit in study area which is not applicable for drinking, domestic, livestock, irrigation and biotic life. Measures are required to stop discharge of untreated wastewater of Sugar Mills and agro-chemical for avoiding polluting canals, natural water ways, drains and water bodies.

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