

Assessment of chemistry of soil irrigated on Phuleli canal

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Abstract: Phuleli canal in Hyderabad is main water supply source for both irrigation as well as human drinking purpose. Quality of the canal deteriorates while passing through Hyderabad city, 2nd largest city of Sindh, Pakistan because highly toxic effluent from plastic factories, illegale cattle pens, slaughterhouses and munciple sewage water are directly discharge into the phuleli canal without any treatment. Soil is a basic requirement for supporting the life on earth, but all over the world soil fertility decreasing by different ways including waste water and solid waste. In Pakistan soil is polluted by different ways out of which untreated liquid waste is main cause of soil pollution. The sewage and industrial liquid waste released in canals and streams without any treatment, which used for irrigation by which soil get polluted. This study was carried out to find out the facts about soil pollution by sewage, in this purpose Phuleli canal was selected, this canal carry the liquid waste of Hyderabad and for the desired study different parameters were investigated.

Keywords: Sewage, Liquid Waste, Irrigation, Soil Pollution

1. Introduction

Sewage contains organic matter, heavy metals, organic compounds, and human pathogens which are extremely harmful when sewage utilized in agricultural for irrigation (A.Khan, et al., 1994; Wagner Bettiol and Raquel Ghini, 2011). Contamination by heavy metals in soils also strongly affects the environmental quality (Mohammad Wahsha et al., 2012).

Phuleli is an irrigation canal and is located in Sindh at Latitude: 25°10'11.92" and Longitude: 68°28'23.26", Pakistan. The elevation of canal is 21 meters. Phuleli canal takes off from left bank of Indus River at kotri barrage to transfer river water for agriculture purpose in Hyderabad and sujawal sub-division. Hyderabad city with a population of about 1.5 million is throwing its untreated sewage, mostly from northern part into Phuleli canal while passing through the city, sewage is added from different locations i.e from cantonment area where water is pumped into the Phuleli canal, sewage from Hirabad, Khuwaja colony, Silawat para

and Northern part of Liaqat colony is collected in a main drain (nallah) which flows by gravity into the Phuleli canal near Kali Mori, sewage pumped into canal near village Darya Khan Panhwar and from an old Power House situated near Phuleli canal.

Phuleli also accepts all of sewerage of Hyderabad city, toxic substance of vehicles and bangle industries, liquid waste of slaughter houses and poultries and also heavily contaminated affluent of industries from Hala Naka to Husri and the affluent also includes Asia's biggest cement factory the Zeal Pak. There are numbers of Villages surrounding near to phuleli canal, Therefore population of living near to phuleli canal at risk of human health problem.

Untreated Sewage contain lot of Heavy metals (N. Sridhara Chary et al., 2008) which affect on soil microbial activity (P. C. Brookes and S. P. Mc Grath, 2006), Sewage affects aquatic bodies (K.-J. winter and D. Goetz, 2003), different types of crops and soil (Steve et al., 1995; Raúl S.

Lavado, 2006;) and underground water quality (S.C. Wilson *et al.*, 1996). Sludge in sewage also unease for organisms and the environment (M. Ghaedi *et al.*, 2008; Ulrika Olofsson *et al.*, 2012). Soil pollution decrease crop yields (Munir J. *et al.*, 2007).

Prosperity of Pakistan is depending on Agriculture, but agriculture of Pakistan decreasing dramatically due to damaging of soil fertility. Untreated sewage is the largest cause of soil pollution in Pakistan (Muhammad K. Jamali *et al.*, 2009) this sewage contains large number of contaminates, which rests on soil, when soil irrigated by water containing untreated sewage (K.P. Singh *et al.*, 2004).

2. Material and Method

Five stations were selected for the soil sampling beside the Phuleli canal. Sample No.1 from C.I.A center, Sample No.2 from Bhatti Village, Sample No.3 from Darya Khan Panhwar Village, Sample No.4 from Nara Jail and sample No.5 from Pono Koli Village near Zeal Pak (Lorlyn Reidy *et al.*, 2013).

The samples were analyzed for loss in weight on air drying at 40 °C, loss of weight at 105 °C and 550 °C (Margarita Miranda *et al.*, 2010), pH, Conductivity, chlorides, Phosphate, nitrate, iron, manganese, zinc, copper, nickel, cobalt, lead, chromium and cadmium (Liu *et al.*, 2006; Liu *et al.*, 2007; Li *et al.*, 2010; Zhao *et al.*, 2012; Zhiyuan Li *et al.*, 2014).

The sampling stations were based in agricultural fields. Samples were brought in laboratory, after drying and gridding; solution was prepared and filtered with Whitman 42 filter paper in 100 ml flask, marked to 100 ml with deionized water (Liu *et al.*, 2006; Liu *et al.*, 2007; Li *et al.*, 2010).

pH was noted with pH meter and conductivity was measured by pre calibrated Orion 115 conductivity meter with pre cleaned electrode by inserting it in the water body of samples.

For determination of Chloride samples were noted by dissolved (25g) in 10 ml quantity of distilled water (few drops) silver nitrate solution was added in order to produced slight red precipitated, allowed to stand overnight and filtered. The volume was made up to 1 liter with deionized water. Silver nitrate by dissolved (2.48g) silver nitrate in 1 liter deionized water. Sodium chloride by dissolved (16.28g) sodium chloride in 1 liter deionized water. Silver nitrate solution was standardized with sodium chloride solution using potassium chromate solution as indicator.

Two dishes were taken, one dish 25ml water sample in other dish 50ml distilled water were added. 1.0 ml of potassium chromate solution was also added in each dish. Standardized silver nitrate was filled in the burette and added drop in the sample dish until first reddish color appeared, compared this with the original color of the distilled water and chromate mixture in the second dish, the consumed volume of silver nitrate was measured.

The soil samples were also analyzed for metal content of iron, manganese, copper, nickel, Cobalt, lead, chromium and cadmium (Raül S. Lavado, 2006). After acid digestion and

Atomic-absorption (AA) spectrophotometer was used.

3. Result and Discussion

Heavy metals contaminations threatening human health by their impact on ecosystems, water and food quality (Bini *et al.*, 2010 and Lim *et al.*, 2008). In Pakistan various kind of researches has been carried out on soil pollution by contaminated water (S.T. Abbas *et al.*, 2007) studied contaminated water of Nullah Dek on fine rice paddy and straw yields and trace elements accumulation in different parts of rice plants and soil, near the bank of Nullah Dek at Kot Pindi Das in the District of Sheikhupura, Pakistan. (A. Ghafooret *et al.*, 1994) worked on chemical composition of effluents from different industries of Faisalabad city. (M Qadir *et al.*, 1997) investigate metal ion contamination in vegetables and soils irrigated with city effluents. (S.Khan *et al.*, 2002) worked on investigation of pollutant load in waste water of hayatabad, Peshawar.

Loss on ignition corresponded to the organic portion and fluctuated between 0.786 to 5.22%. pH of soil was observed with acceptable limits of 7.18 to 8.32 for irrigation purpose, it is may be due to heavy organic and inorganic load in soil. The soil extract (1:2) analyzed for conductivity and nitrate indicated the parallel results with over all ranges observed during the study were 260 to 1560 $\mu\text{S}/\text{Cm}$, (Table.1.) and 0.285 to 8.815 mg/100 g (Table.1.) respectively.

(B.J. Radford *et al.*, 2009) studied on soil chloride and deep drainage response to land clearing for cropping at seven sites in central Queensland, northern Australia. (Sheldon *et al.*, 2004) worked on effect of salinity on plant available water. (Changrong Ke *et al.*, 2013) studied on impacts of chlorides de-icing salts on black soils fungi and bacterial pollutions surrounding the plants rhizosphere. (Sheldon *et al.*, 2004). Worked on effect of salinity on plant available water (Changrong Ke *et al.*, 2013). Studied on impacts of chlorides de-icing salt bulk soils, fungi, and bacterial population surrounding the plant rhizosphere.

The result of soil analysis indicated acceptable values of pH, nitrogen and phosphorus contents for the irrigation purpose. The concentration of the toxic metal ions lead, chromium and were present up to 37.291 $\mu\text{g}/\text{g}$ and 34.78 $\mu\text{g}/\text{g}$ respectively. It was found that samples from upward were less contaminated than down ward and it may be due to excessive disposal of untreated sewage. Untreated Sewage impacts aquatic bodies, soil and food. It is harmful to all organisms. Metal ions are non degradable they magnify in organism. They may cause damage nervous system (lead). High concentration of these metallic ions may also cause alteration of metabolism and genetic mutation.

The metal ions in soil were present at largest concentration; Metals are bound to soil materials by different chemical bonds (G.Q.Liu *et al.*, 2006). Zinc was within the range of 2.158 to 77.69 $\mu\text{g}/\text{g}$ (Zinc), other hand (EPA. S.R.O. 549 (I)/2000) limit for zinc is 5mg/l, highest concentration of zinc was found in sample No.4, which was collected from near Nara Jail.

Iron is not considered toxic unless its highest concentration above than 1000 mg/g (A.Kabata-Pendias, 2007). In study area concentration of iron was up to 17 microgram per gram and this was in sample 3, collected from Darya Khan Panhwar Village. According (EPA. S.R.O. 549 (I)/2000) limit of iron is 8mg/l.

Halim Avci and Tugrul Deveci, 2013 investigate contamination of field soil and crops results from irrigation using municipal and industrial wastewater. According to their study Cadmium is not an essential plant nutrient and can have toxic effects at relatively low concentrations. In study area high concentration of cadmium was found in sample 4, Up to 10 ug/g (Fig.13), so it may accumulate in tissues of plants and easily transferred to consumers.

Cobalt is micronutrient for soil but other concentration of metls may inhibit its required amount in soil. According to (A.Kabata-Pendias and Mukherjee, 2007;S.T.Abbas, *et al.*,2007and R.X.Zhao, *et al.*,2012) the concentrations of Coin plant foodstuffs vary from 8 to 170 $\mu\text{g kg}^{-1}$; tomato fruit concentrations were 20–62 $\mu\text{g kg}^{-1}$. Leafy plants, such as lettuce, cabbage and spinach have a relatively high Co content, whereas Co is lower in grasses and cereals, this study was carried out in Turkey. In current study Co was

found up to 16.5 ug/g (Table.1).

Copper concentration was found up to 24.94 ug/g (Table.1), (EPA. S.R.O. 549 (I)/2000) its limit is 1mg/l. copper is essential element but its excess may result in membrane damage and suppression of enzyme activities (B.Alaoui-Sosse *et al.*, 2004).. Other hand (Halim Avci and Tugrul Deveci, 2013) reported that when pH accedes than 7 availability of copper reduced drastically. Interactions between Ca and Cu may also affect the bioavailability of Cu (A.Kabata-Pendias and Mukherjee, 2007 S.T.Abbas, *et al.*,2007; R.Zahao *et al.*,2012).

Nickel is study area was found up to 32 ug/g (Table.1). (Adriano, 2001 S.T.Abbas, *et al.*,2007) reported that nickel concentrations in field-grown crops and natural vegetation range from 0.05 to 5.0 mg kg. According (EPA. S.R.O. 549 (I)/2000) standard limit of nickel in waste water is 1 mg/l.

Lead is another non essential element in soil. In current study ead concentration was found up to 35 ug/g (Table.1). This is highest concentration can be understated from (EPA. S.R.O. 549 (I)/2000) according which standard limit of lead is 0.5 mg/l. Mean Pb concentrations in food plants grown in several countries range from 0.2 to 2.4 mg kg (Halim.Avci and Tugrul Deveci, 2013).

Table 1. Quantitative analysis of soil irrigated on Phuleli canal water; average value ($n=8$) with \pm confidence interval at 95%. The values in percentage are minimum maximum.

Parameters	Near C.I.A Centre	Bhatti Village	Darya Khan Panhwar Village	Nara Jail	Pono Koli Village near Zeal Pak
pH values	7.87 \pm 0.54 (7.18-8.22)	7.72 \pm 0.28 (7.40-8.30)	7.83 \pm 24 (7.54-8.24)	7.93 \pm 0.22 (7.66-8.32)	7.97 \pm 0.311 (7.53-8.33)
Conductivity $\mu\text{S/Cm}$	654.57 \pm 239 (423-1180)	583 \pm 171 (420-869)	787.5 \pm 410.3 (260-1560)	622.2 \pm 287.2 (1360-1200)	698.6 \pm 235.4 (603-1060)
Loss of Air drying at 40 oC (%)	2.98 \pm 2.57 (0.294-7.27)	3.345 \pm 2.632 (0.140-8.80)	787.5 \pm 3.282 (0.242-9.380)	3.613 \pm 4.684 (0.288-13.34)	2.583 \pm 1.3 (0.237-9.594)
Loss of H ₂ O at 105 oC (%)	3.056 \pm 2.9 (0.287-9.38)	3.948 \pm 2.2189 (0.89-8.80)	3.255 \pm 3.040 (0.505-9.747)	3.436 \pm 0.986 (0.34-8.076)	1.035 \pm 0.863 (0.75-5.00)
Loss on ignition at 550 oC (%)	2.593 \pm 0.99 (0.786-3.8)	3.1310 \pm 1.227 (1.285-5.22)	0.853 \pm 0.458 (1.95-3.517)	3.052 \pm 1182 (1.517-3.965)	2.69 \pm 1.0281 (1.148-3.94)
Chloride $\mu\text{g/g}$	1.112 \pm 1.02 (0.489-380)	1.507 \pm 1.505 (0.498-4.328)	0.759 \pm 0.1775 (0.803-2.203)	0.650 \pm 0.162 (0.498-0.708)	0.877 \pm 0.191 (0.492-0.708)
Phosphate $\mu\text{g}/100\text{g } n=5$	1.30 \pm 1.367 (0.30-3.02)	1.363 \pm 1.084 (0.137-2.62)	1.425 \pm 0.719 (0.803-2.348)	1.246 \pm 1.234 (0.241-3.5)	2.346 \pm 2.521 (0.241=252)
Nitrate $\mu\text{g}/100\text{g}$	3.326 \pm 2.40 (0.65-8.815)	2.266 \pm 0.853 (1.04-3.8)	2.879 \pm 1.403 (1.881-5.93)	1.746 \pm 1.218 (0.285-3.757)	2.557 \pm 1.268 (0.516-4.285)
Fe $\mu\text{g/g}$	14.99 \pm 7.80 (2.622-27.4)	16.136 \pm 7.438 (2.55-26.967)	17.021 \pm 5.895 (7.97-27.23)	12.693 \pm 7.89 (2.158-24.8)	9.885 \pm 5.495 (5.82-13.117)
Mn $\mu\text{g/g}$	0.415 \pm 0.06 (0.295-0.5)	0.414 \pm 0.0705 (0.28-0.539)	0.379 \pm 0.073 (0.281-0.49)	0.414 \pm 0.053 (0.38-0.484)	0.5706 \pm 0.388 (0.372-0.415)
Zn $\mu\text{g/g}$	61.70 \pm 27.8 (8.75-3445)	76.714 \pm 44.416 (8.0-108)	58.7555 \pm 367.73 (9.0-163.2)	77.69 \pm 42.366 (62.5-129.7)	63.149 \pm 38.02 (46.1-73.75)
Cu $\mu\text{g/g}$	22.5 \pm 11.49 (23.8-34.5)	16.836 \pm 10.025 (17.0-43.5)	24.94 \pm 9.238 (18.8-32.5)	22.48 \pm 19.82 (17.5-57.5)	19.482 \pm 11.33 (17.5-35.28)
Ni $\mu\text{g/g}$	32.05 \pm 21.6 (29-77.7)	26.838 \pm 10.25 (27-42.5)	24.942 \pm 9.238 (28.8-50.5)	22.489 \pm 16.827 (38.5-83)	19.482 \pm 11.339 (30.75-45.25)
Co $\mu\text{g/g}$	11.629 \pm 8.501 (8.7-24)	9.052 \pm 4.439 (9.0-13.5)	13.9 \pm 3.025 (11.0-15.0)	15.916 \pm 3.938 (10.75-80.0)	16.583 \pm 3.855 (9.0-26.75)
Pb $\mu\text{g/g}$	25.87 \pm 17.5 (24.62.25)	20.835 \pm 12.275 (18.0-38.5)	37.291 \pm 10.95 (20.5-58.0)	35.82 \pm 19.143 (21.5-57.0)	21.89 \pm 16.856 (13.2-39.5)
Cr $\mu\text{g/g}$	32.2 \pm 10.11 (17.8-51.2)	17.93 \pm 10.49 (13.5-37.0)	25.73 \pm 15.29 (13.0-0.60)	34.78 \pm 20.378 (33.5-63.61)	25.856 \pm 15.93 (20-48)
Cd $\mu\text{g/g}$	5.85 \pm 1.601 (10.3-4.0)	2.295 \pm 1.503 (0.325-4.0)	3.66 \pm 0.5387 (3.0-4.75)	10.2 \pm 11.587 (3.25-5.0)	9.916 \pm 3.096 (3.0-7.5)

Cd/Zn ratio in plant tissues is usually 0.01 or less (Kelling *et al.*, 1977) Same kind of results were also got from these studies (Khan *et al.*, 1994; Younas *et al.*, 1999; Ibrahim *et al.*, 1998; Ghafoor *et al.*, 1995; Ghafoor *et al.*, 1996; Ghafoor *et al.*, 1999).

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