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Impact of Solid Waste Effect on Ground Water and Soil Quality in Town Deeg (Bhratpur) Rajasthan

Abstract

The leachate produced by waste disposal sites contains a large amount of substances which are likely to contaminate ground water. The impact of such sites upon ground water can be judged by monitoring the concentration of potential contaminants at a number of specific monitoring points.Soil and groundwater samples were collected in the Deeg Solid waste landfill-site in district bharatpur(Rajasthan) to study the possible impact of solid waste effect on soil and ground water quality. The physical and chemical parameters such as temperature, pH, hardness, electrical conductivity, total dissolved solids, total suspended solids, alkalinity, calcium, magnesium, chloride, nitrate, sulphate, phosphate and the metals like sodium, potassium, copper, manganese, lead, cadmium, chromium, nickel, palladium, antimony were studied using various analytical techniques. It has been found that most of the parameters of water are not in the acceptable limit in accordance with the BIS,1991 and WHO,2008 Drinking Water Quality Standards. It is concluded that the contamination is due to the solid waste materials that are dumped in the area. The study has revealed that the ground water quality does not conform to the drinking water quality standards as per Bureau of Indian Standards

Keywords: Deeg(Bharatpur), water quality,physicochemical, ground water, solid waste.

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Introduction

In this study, the quality of ground water around a municipal solid waste disposal site in Deeg (Bharatpur) was investigated. Chemical analyses were carried out on water samples collected at various radial distances from the boundary of the dumping yard, at intervals of 3 months and for a period of 3 years. The effects of dumping activity on ground water appeared most clearly as high concentrations of total dissolved solids, electrical conductivity, total hardness, chlorides, chemical oxygen demand, nitrates and sulphates. Leachate collected from the site showed presence of heavy metals. The contaminant concentrations tend to decrease, during the post monsoon season and increase, during the pre monsoon season in most of the samples.

Enormous amounts of solid waste produced in and around urban areas are dumped in town Deeg solid waste landfill site (Fig. 1 and 2). This municipal solid waste normally termed as “garbage” is an inevitable byproduct of human activity which is disposed through dumping (Fig.1). Solid waste land filling is the most common method of solid waste disposal .The landfill site in Deeg are open dumpsites, because the open dumpsites are low operating costs and lack of expertise and equipment provided no systems for leach ate collections(Dinesh et al. 2005 and binukumari et al.2006). Open dumps are unsightly, unsanitary, and generally smelly. They attract scavenging animals, rats, insects, pigs and other pests. Surface water percolating through the trash can dissolve out or leach harmful chemicals that are then carried away from the dumpsites in surface or subsurface runoff.

Among these chemicals heavy metals are particularly insidious and lead to the phenomenon of bioaccumulation and biomagnifications. These heavy metals may constitute an environmental problem, if the leachate migrates into the ground water. The presence of bore well at the landfill sites to draw ground water threatens to contaminate the ground water(Brown et al.2007 and Eamues et al.2006) .A water pollutant is a chemical or physical substance present in it at the excessive levels capable of causing harm to living organisms. The physical hazards are the dissolved solids and suspended solids. The chemical hazards are the copper, manganese, lead, cadmium, phosphate, nitrate etc. As the public health concern, the ground water should be free from physical and chemical hazards. The people in and around the dumping site are depending upon the ground water for drinking and other domestic purposes. The soil pollution arises due to the leaching of wastes from landfills and the most common pollutant involved is the metals like copper, lead, cadmium, mercury etc., The Contamination of ground water and soil is the major environmental risk related to unsanitary land filling of solid waste. The study of Impact of solid waste on water quality of town deeg reveals that the area is heavily pollute(Gannet et al.2007, Garg et al.2008 and Kumar and Alappat 2003) and Impacts of solid waste on health

The group at risk from the unscientific disposal of solid waste include – the population in areas where there is no proper waste disposal method, especially the pre-school children; waste workers; and workers in facilities producing toxic and infectious material. Other high-risk group includes population living close to a waste dump and those, whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury, and infection. In particular, organic domestic waste poses a serious threat, since they ferment, creating conditions favorable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable. Exposure to hazardous waste can affect human health, children being more vulnerable to these pollutants. In fact, direct exposure can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. Many studies have been carried out in various parts of the world to establish a connection between health and hazardous waste. Waste can expose people to chemical and radioactive hazards. Uncollected solid waste can also obstruct storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease(Kannan et al.2005 ,Gupta and Kumar 2002 and Shivakar et al. 2009). Waste dumped in the a water source also causes contamination of the water body or the ground water source. Direct dumping of untreated waste in rivers, seas, and lakes results in the accumulation of toxic substances in the food chain through the plants and animals that feed on it. Disposal of hospital and other medical waste requires special attention since this can create major health hazards.

This waste generated from the hospitals, health care centres, medical laboratories, and research centres such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non-infectious waste.

Reviev of Literature

Physico–chemical and solid wastes studies of water and soil have been undertaken by various workers. To mention a few significant contributions are those of Kannan et al. (2005) studied the physico-chemical characteristics of ground water samples mixed with effluents discharged from textiles industries at Karur district and revealed that the elevated levels of Ca, Mg, Na, Cr, K, Ni, Cu, Zn, CO_3, SO_4, NO_3, and Cl with high values of electrical conductivity (EC) and the water was found to be hard brakish while Binukumari et al. (2006) evaluated the suitability and water quality criteria of the open drainage municipal sewage water at Coimbatore and revealed that physico-chemical parameters like pH, EC, TDS, DO, BOD and COD exceed the permissible limit, indicating the need of proper treatment of waste water before discharge into the Noyaal river Prakash and Somashekar (2006) analysed the physico–chemical and biological quality of water of Anekal Taluk Bangalore Urban district to evaluate its suitability for potable purposes and found that ground water quality is gradually getting deteriorated and may deteriorate further with time and so public should be made aware about the water quality importance and hygienic conditions before use while Madhnure et al. (2007) reported occurrence of fluoride in the ground waters of Pandharkawada area, Yavatmal district, Maharashatra and revealed that ground water of the area is of bicarbonate (HCO_3^-) type and has high fluoride (F^-) concentration in deeper aquifers compared to shallow aquifers and physico–chemical condition like decompostion, dissociation and subsequent dissolution along with long residence time might be responsible for leaching of F into the ground water and Garg et al. (2008) analysed water quality of Bharatpur city (Rajasthan) in post–monsoon season and noted that the water of the study area is highly contaminated with total dissolved solids which causes loss of potability and reduction of solubility of oxygen in water and due to this impure water people of Bharatpur area are facing many problems like stomach diseases, gastric troubles etc while at some points nitrate is also high than the permissible limit and it is recommended that water should be used after boiling because after boiling the temporary hardness (carbonate hardness) can be removed (do not attempt to remove the nitrate by boiling) and the concentration of total dissolved solids can also be decreased and alum treatment is also a good option to make the water potable and Kumar et al. (2008) reported nitrate pollution in dug well water of Putki–Balihari Colliery area of Dhanbad district (Jharkhand) and observed that the nitrate content in water varied from 2– 30, 8–45, 12–65 mg/L. while Batheja et al. (2009) described preliminary nitrate remediation abilities of active neutral alumina, activated charcoal, agar, yellow mustard and betonite in singular or combined form with some limitations and these remedial measure can prove to be helpful in reduction of nitrate concentration in ground water of the study area to appreciable extents. Shivakar et al. (2009) analysed well water quality in and around Dombivili region (Thane) and the physico –

chemical parameters were found in variable concentrations than the permissible limits set by WHO and ISI (10500) standards for drinking water Onyido et al. (2009) surveyed vectors of public health diseases in undisposed refuse dumps in Awka Town, Anambra state, Southeasthern Nigeria and the results showed the relative abundance of the vectors of parasitic diseases such as bacterial, protozoal and viral infections in improperly disposed refuse dumps and the abundance of these vectors suggested that vector–born diseases may be prevalent in Awka while Roy (2009) evaluated fluoride affected areas in Raisen district and preventionary step to get safe potable water and observed that fluoride has an affinity for calcium and get accumulated in bones resulting in mollting of teeth, skeletal fluorosis, bending of legs, deformation of knees joints and even paralysis. while Singh and Gupta (2009) assessed ground water quality of town Deeg district Bharatpur (Rajasthan) and revealed that the well water of Nagar road was moderately polluted however, hand pump water of Nagar raod and well & hand pump water of Goverdhan road were found severely polluted and unfit for human consumption for any purpose. Gupta and Singh (2010)

a) Investigated the physico–chemical and microbiological status of ground water during post–monsoon season in town Deeg (Bharatpur) Rajasthan and found that the water is not suitable for drinking purpose as it contains very high amount of TDS, nitrate, fluoride, salinity, chloride and as compared to prescribed limits of ISI and also proposed the measures of mitigation like the use of yellow mustard, water boiling and adoption of water recharge system. Again, Gupta and Singh (2010)
b) observed physico–chemical quality of ground water during monsoon season of town Deeg (Bharatpur), Rajasthan and found high levels of fluoride, TH, CaH, TDS and chloride when compared to ISI standards and Gupta and Singh (2011) analysed seasonal variation in nitrate and fluoride in ground water of town Deeg (Bharatpur) rajasthan and revealed that all the samples of ground water (hand pump and well) exhibit nitrate content very much higher in all seasons.

Seasonal variation in the levels of nitrate is evident i.e. minimum in post-monsoon somewhat higher in pre-monsoon and highest in monsoon season. The seasonal variation in fluoride content indicates that during monsoon the levels of fluoride are less than pre and post monsoon seasons. Well water contains more fluoride than hand pump in the present study.

After a careful review of the literature cited in the preceding paragraphs, it is quite clear that the physico–chemical and biological analysis of water and its impact on human population of town Deeg have not been studied so far. It is therefore, the present investigation has been undertaken.

Objectiv of Study

Waste treatment and disposal sites can also create health hazards for the neighborhood. Improperly operated incineration plants cause air pollution and improperly managed and designed landfills attract all types of insects and rodents that spread disease. Ideally these sites should be located at a safe distance from all human settlement. Landfill sites should be well lined and walled to ensure that there is no leakage into the in theby ground water sources. Recycling too carries health risks if proper precautions are not taken. Workers working with waste containing chemical and metals may experience toxic exposure. Disposal of health –care wastes require special attention since it can create major health hazards, such as Hepatitis B and C, through wounds caused by discarded syringes. Rag pickers and others who are involved in scavenging in the waste dumps for items that can be recycled may sustain injuries and come into direct contact with these infectious items. Diseases: Certain chemicals if released untreated, e.g. cyanides, mercury, and polychlorinated biphenyls are highly toxic and exposure can lead to disease or death. Some studies have detected excesses of cancer in residents exposed to hazardous waste. Many studies have been carried out in various parts of the world to establish a connection between health and hazardous waste. This study involves the water and soil quality analysis in the Deeg solid waste dumpsite in the area.

Concepts and Hypothesis

To detect the overall effect of solid waste and land filles on ground water and soil quality in Town Deeg (Bharatpur) Rajasthan with the help of physicochemical parameters The basic concept of the study is to understand how the soil and water gets polluted due to the dumping of solid waste

Research Design

Study area

The town Deeg is located on the north of Bharatpur City and lie in between $27^{0}20'$ N latitudes and $77^{0}15'$ E longitudes. The Deeg land filling dumpsite is in the beginning of Kaman road by 200 feet road. Deeg Land filling dumpsite is surrounded by residential areas in which they are heavily affected by both soil and water pollution through the leach out of hazards from the solid waste. The soil and water collected from the Jal mahal which is the solid waste dumpsite. W1, W2 and W3 are the water samples collected in Jal mahal in Deeg landfill dumping site. S1, S2, S3 and S4 are the soil samples collected in Jal mahal in the Deeg landfill dumping site. SW1, SW2, SW3 and SW4 are the solid waste samples collected in the Deeg landfill dumping site.

The Preliminary survey on the quality of ground water, soil and solid waste samples was conducted in the month of January 2011, because the ground water and soil get polluted due to solid waste dumping nearer to the location. The water samples and soil samples were collected along with three grab samples during first week of the month between 8.00 A.M. to 11.00 A.M.

Water

Sample Collection, preservation and analysis were done as per the standard method(APHA,2005 , BIS,1991 andWHO,2008) Water samples were taken at each station. Three water samples were collected at different locations at Jal mahal. The polyethylene sample containers cleaned by 1 mol/L of nitric acid and left it for 2 days followed by thorough rinsing of distilled water. Two litres of samples were collected for the analysis. The generally suitable techniques for the preservation of samples followed as per Indian standard methods. The Ph, Electrical conductivity, Total alkanity, hardness and chloride test were done at the site. Total suspended solids. Nitrate, phosphate and sulphate were analysed as soon as possible. The samples for trace metal analysis were acidified with concentration HNO_3 to bring Ph < 2.

Soil samples

Sample collection, preservation and analysis were done as per the standard methods (Kumar and Alappat 2003 and U.S.EPA1983,2006).

The representative soil samples were collected as per standard methods. The sampling of soil was done using hand augur. The augur was used to bore a hold to the desired depth and then withdrawn. The samples were collected directly from the augur. The sampling area first to be cleaned and first six inches of surface soil was removed with the radius of 6 inches around the drilling location. Begin auguring, periodically removed and deposited accumulated soil onto the plastic sheet. After reaching the desired depth slowly and carefully removed the augur from the hole and the samples were directly from the augur. The composite samples collected and they were kept in the suitable labeled container. The collected soil samples were protected from sunlight to _ulveriz any potential reaction. The dry soil samples for various tests were prepared as per the _ulver standard method**.** The received soil samples dried in sun or air and the pulverization was done. The _ulverized soil was passed through the specified sieve and taken for various analysis.

Solid waste samples

500 g of representative solid waste samples were collected in the different places of Deeg Landfill site on 5th January 2011. The solid waste samples were collected as per the standard procedure (Trivedi and Goyal ,1986).

Analysis in study laboratory

The station-wise distributions of analytical parameters such as physical parameters and metals are shown in Tables 1, 2 and 3 and the analysis was one as per the standard methods.(Indian standard methods) IS 3025 (Part I) – 1987(Reaffirmed 1998), Edition 2.1 (1999 -12) and U.S.EPA1983,2006).).

Figure:1- Solid wastes and landfills around the Hand pump of town Deeg, Bharatpur (Rajasthan)

Figure:2- **Solid wastes and landfills in wells of town Deeg, Bharatpur (Rajasthan)**

Significant Findings

Chemical Characteristics

PH of water samples varies from 5.24 to 6.59. The acceptable limit for the drinking water standard is 6.5 – 8.5. Since W2 does not lie in the limit, it is not suitable for drinking. The Ph of soil varies from 6.3 to 7.0 and the solid waste sample varies from 6.4 to 7.3. Total alkalinity values vary from 40 mg/L to 260 mg/L. The desirable limit for total alkalinity is 200 mg/L and the permissible limit in the absence of alternate source is 600 mg/L. The total alkalinity value of water sample S2 is very lower as compared to the standard. Hardness of water sample varies from the 450 mg/L to 669 mg/L. The desirable limit for hardness is 300 mg/L and the permissible limit in the absence of alternate source is 600 mg/L. The calcium concentration varies from 107 mg/L to 169 mg/L and the magnesium concentration varies from 22.5 to 60.1 mg/L. The desirable limit for calcium is 75 mg/L and the permissible limit in the absence of alternate source is 200 mg/L. The desirable limit for magnesium is 30 mg/L and the permissible limit in the absence of alternate source is 100 mg/L. Chlorides are not usually harmful to people; however, the sodium part of table salt has been linked to heart and kidney disease(Prakash and somashekar 2006,Roy 2009 and Sampat 2000). Sodium chloride may impart a salty taste at 250 mg/L; however, calcium or magnesium chlorides are not usually detected by taste until levels of 1000 mg/L are reached. The desirable limit for chloride is 250 mg/L and TDS is generally considered not as a primary pollutant, but it is rather used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of presence of a broad array of chemical contaminants(Gupta and Singh 2009,2010, (a,b) Gupta and sharma2009 and Gupta and verma 2007). The values for the present water samples vary from 1622 mg/L to 1809 mg/L. The desirable limit for TDS is 500 mg/L and the permissible limit in the absence of alternate source is 2000 mg/L. The TDS levels of the water come within the limit. Total Suspended Solids (TSS) (measure of the mass of fine inorganic particles suspended in the water values) are in between 24 and 42 mg/L. Nitrate is one of the most common groundwater contaminant. The excess levels can cause methemoglobinemia, or “blue baby” disease(Batheja et al.2009 and Kumar et al.2008).

Although nitrate levels that affect infants do not pose a direct threat to older children and adults, they do indicate the possible presence of other more serious residential or agricultural contaminants, such as bacteria or pesticides. Nitrate in groundwater originates primarily from fertilizers, septic systems, and manure storage or spreading operations. The permissible limit for the nitrate is 45 mg/L. The water samples are in the range of 22.35 to 26.37 mg/L. All the samples are within the permissible range. Sulfate can be found in almost all natural water. The origin of most sulfate compounds is the oxidation of sulfite ores, the presence of shales, or the industrial wastes (Roy2007). Sulfate is one of the major dissolved components of rain. High concentrations of sulfate in the water we drink can have a laxative effect when combined with calcium and magnesium, the two most common constituents of hardness. The sample contains the sulphate concentration in the range of 351 to 487 mg/L. The desirable limit for sulphate is 200 mg/L and the permissible limit in the absence of alternate source is 400 mg/L. The samples W2 and W3 are not suitable for drinking. Phosphorus is usually present in natural water as phosphates (orthophosphates, polyphosphates, and organically bound phosphates). Sources of phosphorus include human and animal wastes (i.e., sewage), industrial wastes, soil erosion, and fertilizers. Excess phosphorus causes extensive algal growth called “blooms,” which are a classic symptom of cultural eutrophication and lead to decreased oxygen levels in creek water. The water samples contain 0.11 to 0.16 mg/L of phosphate. Sodium is an essential nutrient. The Food and Nutrition Board of the National Research Council recommends that most healthy adults need to consume at least 500 mg/day, and that sodium intake be limited to no more than 2400 mg/day. Reza and singh2009. This low level of concern is compounded by the legitimate criticisms of EPA’s 20 mg/L [Drinking Water Equivalency Level (DWEL) or guidance level] for sodium. The maximum permissible level of sodium is 200 mg/L as per WHO guidelines. The present water is having higher concentration as compared to DWEL Level. The sodium level of water is ranging from 449.8 mg/L to 482.2 mg/L.

Metals

Copper

The desirable limit for copper is 0.05 mg/L and the permissible limit in the absence of alternate source is 1.5 mg/L. The undesirable effect beyond the desirable limit is astringent taste, discoloration and corrosion of pipes, fittings and utensils will be caused. The present water samples are having copper ranging from 0.221 mg/L to 0.478 mg/L. Hence, all water samples are contaminated due to copper and not suitable for drinking.

Manganese

The desirable limit for manganese is 0.1 mg/L and the permissible limit in the absence of alternate source is 0.3 mg/L. Beyond this limit taste and appearance are affected and has the adverse effect on domestic uses and water supply structures. The present water samples are ranging from the 0.142 to 2.360 mg/L.

Cadmium

The permissible limit for cadmium is 0.01 mg/L. Beyond this the water becomes toxic. The samples are in the range 0.010 to 0.014 mg/L, slightly more to the permissible limit.

Nickel

The desirable limit for nickel is 0.07 mg/L as per the WHO guidelines for drinking water quality, 2006. The samples are in between 0.029 to 0.154 mg/L. S2 is beyond the limit.

Lead

The permissible limit for lead is 0.05 mg/L. The water sample has no appreciable concentration of lead and it is found to be below the detection level. The detection level is 0.01 mg/L.

Chromium

The permissible limit for chromium is 0.05 mg/L. The water sample has no appreciable concentration of chromium and it is found to be below detection level. The detection level is 0.03 mg/L.

Mercury

The permissible limit for mercury is 0.001 mg/L. The water sample W1 has the concentration of 0.00087 mg/L and the other two water samples have no mercury content.

Modernization and progress has had its share of disadvantages and one of the main aspects of concern is the pollution. It is causing to the earth land, air, and water. With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into the landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and problems to the surrounding environment. Waste that is not properly managed, especially excreta and other liquid and solid waste from households and the community, are a serious health hazard and lead to the spread of infectious diseases. Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease. Normally it is the wet waste that decomposes and releases a bad odour. This leads to unhygienic conditions and thereby to a rise in the health problems. The plague outbreaks in Surat is a good example of a city suffering due to the callous attitude of the local body in maintaining cleanliness in the city. Plastic waste is another cause for ill health. Thus, excessive solid waste that is generated should be controlled by taking certain preventive measures.

Preventive measures

Proper methods of waste disposal have to be undertaken to ensure that it does not affect the environment around the area or cause health hazards to the people living there. At the household-level proper segregation of waste has to be done and it should be ensured that all organic matter is kept aside for composting, which is undoubtedly the best method for the correct disposal of this segment of the waste(Tyagi et al.2002 and Uba andAghogho2001). In fact, the organic part of the waste that is generated decomposes more easily, attracts insects and causes disease. Organic waste can be composted and then used as a fertilizer.

Table-1: Water Quality Parameters of Jal mahal, in the the Deeg Solid waste dumpsite area

Parameters	Ground water W1	Ground water W2	Ground Water W3	Requirement (Desirable Limit)	Permissible limit in the absence of alternative source	Undesirable effect outside the Desirable Limit
Colour, Hazen units, Max	2	1	3	5	25	Above 5, consumer acceptance decreases
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	--	--
Taste	Agreeable	Agreeable	Agreeable	Agreeable	--	--
Turbidity, NTU,Max	1.4	0.8	1.1	5	10	Above 5, consumer acceptance decreases
pH value	6.59	5.24	6.56	6.5 to 8.5	No relaxation	--
Electrical Conductivity @ 25°C , μmhos/cm	2950	3290	3180	--	--	--
Total alkanity as CaCO3,mg/L	260	40	236	200	600	Beyond this limit taste becomes unpleasant
Total Hardness (as CaCO3) mg/L, Max	515	450	669	300	600	Encrustation in water supply structure and adverse effects on domestic use
Calcium mg/L , Max	144	107	169	75	200	Encrustation in water supply structure and adverse effects on domestic use
Magnesium, mg/L,Max	37.6	22.5	60.1	30	100	Encrustation in water supply structure and adverse effects on domestic use
Chloride , mg/L,Max	729	877	795	250	1000	Beyond this Limit,test,corrosion and palatability are affected
Nitrate , mg/L,Max	22.35	26.37	23.41	45	No relaxation	Beyond this methaemoglobinemia takes place
Sulphate , mg/L,Max	351	487	441	200	400	Beyond this causes gastro intenstinal irritation when magnesium or sodium present
Total Dissolved solids, mg/L	1622	1809	1749	500	2000	Beyond this palatability decreases and may cause gastro intestinal irritation
Total Suspended solids, mg/L	24	38	42	--	--	--
Sodium , mg/L	449.8	482.2	451.5	--	--	--
Potassium , mg/L	22.4	8.0	21.1	--	--	--
Copper , mg/L	0.478	0.388	0.221	0.05	1.5	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this
Manganese , mg/L	2.360	1.410	0.142	0.1	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures

Lead , mg/L	BDL	BDL	BDL	0.05	No relaxation	Beyond this limit the water becomes toxic
Cadmium , mg/L	0.010	0.014	0.012	0.01	No relaxation	Beyond this limit the water becomes toxic
Chromium (as Cr6+), mg/l	BDL	BDL	BDL	0.05	No relaxation	May be carcinogenic above this limit
Nickel , mg/L	0.041	0.154	0.029	--	--	--
Phosphate , mg/L	0.16	0.11	0.11	--	--	--
Mercury , µg/L	0.87	BDL	BDL	1	No relaxation	Beyond this limit the water becomes toxic

Table-2: Soil Quality Parameters of Jal mahal in the the Deeg Solid waste dumpsite area

Parameters	Soil S1	Soil S2	Soil S3	Soil S4
pH @ 25°C	6.40	6.30	6.80	7.00
Electrical Conductivity @ 25°C , µmhos/cm	180.2	523	622	290
Lead, mg/kg	19.3	9.53	7.43	51.52
Cadmium, mg/kg	0.40	0.17	0.27	0.27
Copper, mg/kg	36.55	29.53	43.08	25.28
Manganese, mg/kg	65.89	32.74	57.93	110.8
Chromium, mg/kg	44.28	8.41	7.58	6.50
Nickel, mg/kg	9.52	5.41	6.25	4.68
Mercury, mg/kg	0.19	0.045	0.10	0.027
Moisture, %	7.90	8.47	8.50	8.99

Table-3: Solid Waste Quality Parameters of Jal mahal in the the Deeg Solid waste dumpsite area

Lead, mg/kg	75.08	87.81	62.5	26.74
Cadmium, mg/kg	2.10	1.80	1.52	1.09
Copper, mg/kg	267.9	137.9	66.5	62.5
Manganese, mg/kg	160.2	208.3	172.2	291.6
Chromium, mg/kg	33.8	38.5	28.0	16.3
Nickel, mg/kg	16.0	19.3	16.4	9.51
Mercury, mg/kg	0.37	0.16	0.37	0.098
Moisture, %	2.62	6.84	1.58	2.41

Parameters	Solid waste SW1	Solid waste SW2	Solid waste SW3	Solid waste SW4
pH @ 25°C	**6.40**	**6.70**	**7.00**	**7.25**
Electrical Conductivity @ 25°C , µmhos/cm	**438**	**485**	**315**	**245**

Suggestions

1. The study clearly indicates that landfills in densely populated cities should have the ground water monitored on regular basis.
2. Furthermore, ground water in and around the landfill sites shall not be used for drinking purposes unless it meets specific standards.
3. Indiscriminate dumping of wastes in developed areas without proper solid waste management practices should be stopped.
4. Surface or rainwater should be used instead of ground water in the affected areas after proper treatment.
5. Food rich in calcium and phosphorous are recommended as the rate of accumulation of fluoride in human body decreases when these are consumed in the intestine
6. Recharging the underground aquifer through the rain water harvesting at appropriate locations can reduce the fluoride content significantly through dilution
7. Do not attempt to remove the nitrate by boiling the water. This will only concentrate the nitrate making levels even higher (Gupta and Singh, 2010) a,b.
8. Yellow mustard is effective for the removal of nitrate (Batheja *et al.* 2009).

9. Treatment technologies available in the market for efficient reduction of nitrate in drinking water e.g. electro–dialysis, reverse osmosis, ion exchange must be used.
10. Biological and chemical remediation and mineral treatment (Batheja *et al.* 2009) must be employed.
11. Water should be monitored by the rolling boil then cooling and alum or bleaching treatment before use to minimize the concentration of TDS (Garg *et al.* 2008).
12. Public should be made aware about the water quality importance and hygienic conditions before use.

Conclusion

Due to the physico–chemical parameters (turbidity, NO_3, P, fluoride, TH, alkalinity, Cadmium, lead) which have been revealed beyond the acceptable limits, the water of town Deeg is not fit for potable and other purposes if used without any treatment. Management and conservation measures must be implemented to improve the water quality. The further study such as the estimation of trace elements (As, Zn, Iron,) and pesticides will definitely be fruitful in improving the potability of water in town Deeg (Bharatpur). On the basis of the observations of the present study the following significant findings have been revealed:

1. Very high TDS in well and hand pump water have been observed.
2. Higher turbidity in all ponds indicates the presence of disease causing organisms.
3. The hand pump, well and PHED supply water contains very high TH (very hard drinking water) that may cause cardiovascular problems
4. Concentration of salinity has been noted very high as compared to permissible limit that may be toxic to plant's growth.
5. Phosphorus concentration in the pond water is very high, which indicates eutrophication.
6. All the samples of ground water (hand pump and well) exhibit very much high nitrate content. However, an alarming position with regards to nitrate value in hand pump water of Jal mahal has been noted. This may pose serious health problems like methemoglobinemia in babies, anaemia in infants and pregnant women and formation of carcinogenic nitrosamines, if used for drinking purpose.
7. Water born diseases such as anaemia, diarrhoea, cardiac problems, gastrointestinal disorder and skeletal problems have been found in town Deeg (Bharatpur).
8. Ground water of Goverdhan and Kaman road is not potable due to high TH, nitrate, TDS, chloride, salinity as compared to Nagar road and Jal mahal area.
9. PHED supply water (all areas) is very hard and saline.

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