GROUNDWATER CONTAMINATION

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Executive Summary

Groundwater contamination is a major problem around the world. This is especially true for India, which uses the most groundwater in the world : around ¼ of the total world's groundwater per year. Groundwater contamination affects the health of all living beings because it is a source of drinking water. Groundwater is contaminated due to natural and man-made reasons. Industrial and agricultural waste is a big problem. However, in recent years, solid waste disposal has become a huge issue. In India, waste is dumped almost everywhere and even the landfills that are present are mostly not properly scientifically engineered. Due to this a lot of toxins and chemicals enter groundwater.

This report comprises a survey of various scientific studies on groundwater contamination from improper waste disposal in India. It uses this secondary data to make a link between ground water contamination and human health.

Groundwater contamination poses a big risk to human health and can cause life threatening diseases. The Swacch Bharat Abhiyaan along with the newly promulgated Solid Waste Management Rules, 2016, can be a game-changer with regard to the manner in which waste will be handled, disposed and treated. This in turn will impact the ground water contamination and pollution caused by improperly disposed waste.

Introduction

Groundwater anywhere in the world is a critical resource. However the last few decades have seen a rapid decline in quantity and quality of this life giving and sustaining elixir. Groundwater contamination has emerged as the biggest threat to drinking water which in turn impacts the health of all living beings. In a research on India's groundwater, The World Bank, 2012[1] found that, "ground water exploitation and contamination have emerged across a diverse range of agro-climatic and hydro-geological conditions in India, with nearly 60% of the districts in India showing evidence of either depletion or contamination or both.

Groundwater also serves as a buffer opposing erratic monsoon rains. Currently India is the highest user of groundwater in the world, estimated at 230 cubic kilometers [2]per annum, more than a 1/4th of the global total. In the United States, over 50%[3] of the population depends on groundwater on an everyday basis. These few figures already begin to paint a rather alarming picture of how serious an issue groundwater contamination is in a country like India.

Groundwater contamination can be natural or induced by man. Rocks and sediments contain a number of naturally occurring contaminants. Flowing water may dissolve metals such as iron, manganese and other trace metals which may add to its contamination at a later stage. Urban activities, agriculture, industrial effluents, improper disposal of waste are ways in which anthropogenic activities contaminate the health of groundwater as well as the environment in general. According to the U.S. Geological Survey[4], groundwater contains more dissolved chemicals and gasses than surface water.

1 Bank, T. W. (2012, March 6). India Groundwater: A Valuable but Diminishing Resource. Washington, DC, Washington, DC, United Stated of America: The World Bank Group

2 Ibid.

3 The Groundwater Foundation. (n.d.). *The Groundwater Foundation.* Retrieved July 23, 2015, from Groundwater.org: http://www.groundwater.org/get-informed/groundwater/contamination.html

4 Molly Maupin, J. K. (2014). *Estimated Use of Water in the United States in 2010.* Virginia: United States Geological Survey.

Other than industrial and agricultural discharges causing groundwater pollution, solid waste has become an important source of contamination for groundwater. Various facts, figures and arguments given in this document will reveal why this is the case.

The Ministry of Environment, Forests and Climate Change recently estimated India's annual waste generation at 62 million metric tons[5]. In India, vast amounts of trash are dumped along the roadside and in almost any space available. Landfills too are not scientifically engineered and layered with leachate run off prevention. There are currently less than a handful of sanitary landfills in India. The Achan landfill at Srinagar and the sanitary landfill in Mysore are amongst the few existing scientific landfills in India. However, a number of cities across the country have begun converting existing landfills to scientifically engineered ones or constructing new sanitary landfills at identified sites. Cities such as Jaipur, Bangalore and Delhi are working on plans for construction of scientific sanitary landfills.

Dumps, landfills and illegal roadside dumping areas contain a plethora of household and other products such as plastics, oils, sanitary wastes, pesticides, and solvents among a range of other potentially chemical and toxic products. According to Lenntech, "Human groundwater contamination can be related to waste disposal: private sewage disposal systems, land disposal of solid waste, municipal wastewater, wastewater impoundments, land spreading of sludge, brine disposal from petroleum industry, mine-wastes, deep-well disposal of liquid wastes, animal feedlot wastes, and radioactive wastes." [6]

These put together have today become one of the biggest causes of groundwater pollution. The International Association of Hydrological Sciences has reported cases of groundwater pollution due to landfills and toxic leachate from landfills as among the highest groundwater quality risks globally. This goes to show the urgent need for a shift in manner of disposal of solid waste in our country, in order to preserve water resources.

This goes to show the immediate need to switch to practices such as source segregation, zero waste and treatment of waste before final disposal in landfills.

5 Mallapur, C. (2014, December 12). *India Spend.* Retrieved April 1, 2016, from India Spend Website: http://www.indiaspend.com/cover-story/3-million-truckloads-daily-indias-real-trash-problem-68539

6 LENNTECH. (n.d.). *LENNTECH: Sources of Gorundwater Pollution.* Retrieved July 23, 2015, from LENNTECH: http://www.lenntech.com/groundwater/pollution-sources.htm

Landfill Based Water Contamination in India

The following document is a brief summarization of a number of scientific studies from across the country and the globe where studies conducted have revealed groundwater contamination due to improper disposal of waste. Landfilling is one of the biggest sources of ground water contamination as the following section will reveal. Not only is it a concern for environmental reasons but impacts the health, both directly and definitely, of all living creatures coming in contact with it.

In 2012, a research was carried out at Vendipalayam, Semur and Vairapalayam landfill sites in Erode city of Tamil Nadu to study the possible impact of leachate percolation on groundwater quality. Concentrations of various physicochemical parameters including heavy metals (Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Nickel (Ni), Lead (Pb), and Zinc (Zn) were determined in leachate samples *(see table: Physico-chemical characteristics of leachate at various landfill sites in Erode).* The concentrations of Chloride (Cl^-), Nitrates (NO_3^-), Sulphates (SO_4^{2-}), Ammonia (NH_4^+)were found to be in considerable levels in the groundwater samples particularly near to the landfill

Table 1: Physico-chemical characteristics of leachate at various landfill sites in Erode (in mg/l)

Parameters	Vendipalayam landfill (in mg/l)	Semur landfill (in mg/l)	Vairapalayam landfill (in mg/l)
Fe	63.41	58.91	58.40
Zn	2.10	1.29	1.29
Pb	1.10	1.20	1.31
Ammonia nitrogen NH4+	1932	1622	2231

Source: *Rajkumar Nagarajan, S. T. (2012). Impact of leachate on groundwater pollution due to non-engineered municipal solid waste landfill sites of Erode city, Tamil Nadu, India* sites, likely indicating that groundwater quality was being significantly affected by leachate percolation, reported the researchers from Perundurai-based Kongu Engineering College, and Chennai-based Anna University.[7]

According to the researchers, the high level of Fe (63.41 mg/L) in the leachate sample indicates that iron and steel scrap were also dumped in the landfill at a larger quantity. The presence of Zn (2.10 mg/L) in the leachate showed that the landfill received waste from batteries and fluorescent lamps. “Leachate has significant impact on groundwater quality in the area near to all the three landfill sites. The quality of the groundwater was found to improve with the increase in depth and distance of the well from the landfill site. Although, the concentrations of few contaminants do not exceed drinking water standard even then the groundwater quality represent a significant threat to public health,” the 2012 study concluded.[8]

In 2008, researchers from VHNSN College in Virudhunagar, Tamil Nadu carried out a study to understand the impact of solid waste on groundwater and soil quality near Pallavaram landfill in Chennai. They collected water and soil samples and got them tested for various 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. In order to understand this, we can delve a little deeper in to the effects of these chemicals on human health. We are only taking into account the effects on human health, not considering the effects on animals, plants and environmental health. The occurrence of suspended solids can make a water body carcinogenic, metals on the other hand directly affect the nervous system, mental health and the digestive system. Presented in this paper are only a few effects of certain metals found in ground water in different areas of the country. Researches are available that detail the extent to which many other metals effect human health.

Groundwater pollution due to waste disposal is widespread. It has been reported in Pune city of Maharashtra (2008). For instance, a group of researchers from the Shri Shivaji Science College in Amravati, Maharashtra found groundwater contamination near Uruli Devachi Garbage Depot in Pune. Water samples from 12 dug wells and two streams carrying leachate from the Depot were tested. The results indicate that the water in the streams flowing through the villages around the Garbage depot, and the wells around the villages, had higher values for most of the parameters, thus, indicating contamination of the groundwater. The amount of pollution in the wells decreased with increasing distance from the stream carrying the

7 Rajkumar Nagarajan, S. T. (2012). Impact of leachate on groundwater pollution due to non-engineered municipal solid waste landfill sites of Erode city, Tamil Nadu, India. *Iranian Journal of Environmental Health Science & Engineering*

8 Rajkumar Nagarajan, S. T. (2012). Impact of leachate on groundwater pollution due to non-engineered municipal solid waste landfill sites of Erode city, Tamil Nadu, India. Iranian Journal of Environmental Health Science & Engineering

leachates. The researchers warned that in spite of monsoon season, they found high levels of pollutants in the leachate, and situation would be worse post monsoon (winter) and summer time.[9]

Another city of Maharashtra has come out with similar startling facts. In 2012, two researchers from Solapur University and Aurangabad-based Dr. BAM University collected groundwater samples from near the municipal waste dumpsite in Solapur from January to April 2012 (pre monsoon), and September to December 2012 (post monsoon). They analyzed these samples for various parameters, including fluoride, nitrate, chloride, etc. The results of collected water samples for both seasons showed that the groundwater was not potable within WHO guidelines, particularly in post monsoon season due to high bacterial contamination that may result in many waterborne diseases and other environmental problems.

The researchers concluded that that "the poor practices of waste management carried out at Municipal Solid Waste Dumping site at Solapur city site and the absence of leachate collection system has a great impact on the ground water quality. It is suggested that the concerned authorities should take serious steps for the control of ground water pollution by providing base of cement concrete to insure for the safety of local environment and public health. They are advised to use improved techniques of solid waste management, leachate collection and ground water monitoring on regular basis." [10]

In 2005, a team of researchers' form the Indian Institute of Delhi, in collaboration with researchers from the University Of Antwerp, Belgium conducted a leachate characterization study and assessment of groundwater pollution near the Ghazipur municipal solid waste dumpsite and found startling facts after analysis of the data gathered.

The study revealed that the absence of a leachate collection/run-off prevention layer led to the percolation of a vast amount of leachate below the surface of the landfill into the groundwater below. The study estimated an average of 2200 MT/day of waste are dumped at the site and the site has been operational since 1984, leading to colossal volumes of leachate percolation. In the absence of segregation and treatment of waste, all kinds of waste including biomedical waste are dumped in the landfill. The nature of leachate percolating to the water below is nothing less than toxic and life-threatening. The table below summarizes from the study the contaminants found as well as the quantities in which they were found from samples of the study.

9 Gajanan Wagh, M. R. (2008). Contamination of groundwater due to solid waste disposal in southeastern part of the Pune city, India. *33rd International Geological Congress. Oslo: International Geological Congress*

10 Pawar Ranjitsinh, P. D. (2014). Characterization of Groundwater in Relation to Domestic and Agricultural Purposes, Solapur Industrial Belt, Maharashtra, India. *Journal of Environmental Research and Development,* 102-112

Table 2: **Concentration of various parameters found in leachate and groundwater assessment around Ghazipur landfill site**

Parameter	Concentrations(All in mg 1-1except Ph and EC (µS cm-1)
pH	6.9
EC	24500
TDS	27956
TDVS	14992
FDS	12964
COD	27200
BOD	19000
Na+	545
K+	1590
NH4+	2675
NO2-	Nil
NO3-	380
Si	326
Phenol	0.02
Cd	0.06
Cr	0.29
Cu	0.93
Fe	70.62
Ni	0.41
Pb	1.54
Zn	2.21

Source: *Leachate Characterization and assessment of groundwater pollution near Ghazipur municipal solid waste landfill site, Delhi 2005*

A study conducted by Jawahar Lal Nehru University's Department of Environment conducted between 2012 and 2013 revealed that the grounds oil of the area harbor organic pollutants exceeding the permissible limits by up to 158 times. The study showed the site to be high in compounds such as aliphatics, terpeniods, benzenes, ketones, pharmaceuticals and phthalates which do not degrade and enter the food chain leading to hormone disruption, reproductive disorders, learning disabilities, heart diseases, diabetes and cancer. The Ghazipur site also contains compounds which are cytotoxic, i.e. human cell killing, in nature.

What further exacerbates this problem is the lack of any permissible leachate discharge concentration in India which makes it hard to keep a check on the toxicity of such sites across the country.

The results of the research showed that most of the parameters of water were not in the acceptable limit in accordance with the IS 10500 Drinking Water Quality Standards. The study concluded that the contamination is due to the solid waste materials that are dumped in the area (see tables: Water quality parameters and soil quality parameters in Joy Nagar near Pallavaram landfill).[11]

11 N Raman, D. S. (2008). IMPACT OF SOLID WASTE EFFECT ON GROUND WATER AND SOIL QUALITY NEARER TO PALLAVARAM SOLID WASTE LANDFILL SITE IN CHENNAI. *Rasayan Journal of Chemistry,* 828-836

Table 3: **Water quality parameters in Joy Nagar near Pallavaram landfill (mg/l)**

Parameters (mg/l)	Groundwater samples result (mg/l)	Desirable limit (mg/l) IS 10500: 1991 (as defined in the MSW Rules, 2000)
Chloride	729-877	250
Sulphate	351-487	200
Total dissolved solids	1622-1809	500
Manganese	0.142-2.360	0.1
Cadmium	0.010-0.014	0.01
Nickel	0.029-0.154	–
Phosphate	0.11-0.16	–

Source: *N Raman, D. S. (2008). IMPACT OF SOLID WASTE EFFECT ON GROUND WATER AND SOIL QUALITY NEARER TO PALLAVARAM SOLID WASTE LANDFILL SITE IN CHENNAI*

Table 4: **Solid waste and soil quality parameters in Joy Nagar near Pallavaram landfill (mg/kg)**

Parameters (mg/kg)	Soil sample (mg/kg)	Soil sample (mg/kg)	Solid waste sample (mg/kg)	Solid waste sample (mg/kg)	Desirable limit (mg/kg) IS 10500: 1991 (as defined in the MSW Rules, 2000)
Lead	51.52	19.3	87.81	75.08	0.05
Cadmium	0.40	0.27	2.10	1.80	0.01
Copper	43.08	36.55	267.9	137.9	0.05
Manganese	110.8	65.89	291.6	208.3	0.1
Chromium	44.28	8.41	38.5	33.8	0.05
Nickel	9.52	6.25	19.3	16.4	–
Mercury	0.20	0.11	0.37	0.16	0.001

Source: *N Raman, D. S. (2008). IMPACT OF SOLID WASTE EFFECT ON GROUND WATER AND SOIL QUALITY NEARER TO PALLAVARAM SOLID WASTE LANDFILL SITE IN CHENNAI*

Improper waste disposal is also linked to soil pollution. The leachate generated at bottom of landfill carries numerous contaminants to the soil surface and to adjacent areas. During percolation of leachate through the soil, leachate undergoes various processes such as physicochemical decomposition process, ion exchange reactions, chemical alterations, oxidation, hydrolysis, etc. These reactions alter the soil's original properties. The table above (Table No 4) gives a little insight through figures into the amount of pollutants present in the area around the Pallavaram Landfill Site in Joy Nagar (Chennai). The figures define the amount of metals (in mg) present per kilogram of sampled soil as well per kilogram of solid waste. This gives us an idea of the values by which prescribed limits for certain metals are well beyond the permissible limits and the repercussions these can have.

Take this recent study done at the municipal waste disposal site at Thrissur in Kerala. A group of researchers collected soil and leachate samples from the dumpsite and tested them for various parameters *(see table: Average characteristics of leachate samples).* They found that the physico-chemical parameters of the leachate exceeded the specified standards for disposal into surface water bodies or sources. They also tested soil characteristics and found its properties had changed due to leachate. "Solid waste dumps have some effect on the engineering and chemical properties of soil. Not only does it reduce the overall soil strength and consequently its usefulness as a foundation material, it also can result in pollution of ground water sources due to percolation of toxic and hazardous chemical," concluded researchers from IIT Madras and National Institute of Technology Karnataka.[12]

Table 5: Average characteristics of leachate samples at a municipal waste disposal site in Thrissur (Kerala)

Parameters	Standards for disposal of treated leachate (in mg/l)	Sample results (in mg/l)
COD	250	1152
BOD	30	80
TDS	2100	2560000
Total Alkalinity	600	2915
Total hardness	600	700
Iron	–	4.094
Sodium	200	760
Potassium	–	1525
Chlorides	250	960
Nitrates	–	103.55

Source: Sruti Pillai, A. E. (2014). Soil Pollution near a Municipal Solid Waste Disposal Site in India. International Conference on Biological, Civil and Environmental Engineering.

12 Sruti Pillai, A. E. (2014). Soil Pollution near a Municipal Solid Waste Disposal Site in India. International Conference on Biological, Civil and Environmental Engineering. Dubai: International Institute of Chemical, Biological and Environmental Engineering

Global Landfills Contaminate Ground Water Too

Such cases are prevalent not only in India but all over the world. Take for example geological and hydrological studies on the Isparta Plain, a major groundwater basin in Turkey. The study conducted by Gülçin and Karlik, 2001 revealed that two-thirds of the alluvial aquifers in the region were already contaminated to a large extent by the city sewage system and an open waste-disposal site in which household and various industrial wastes were improperly disposed of. This particular waste disposal site is located on very permeable alluvium. To further this concern, the landfill has not been lined with any leachate collection system. Studies conducted by Karagüzel (1993) and Irlayici (1998) showed NO_3, NO_2, and NH_4 values at almost five times the limit set by the World Health Organization in 1971.[13]

A report compiled by the Department of Primary Industries and Energy under the Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia documenting 106 cases of groundwater pollution across Australia brought out varied reasons for groundwater contamination across a number of basins and aquifers in the continent. The study revealed a host of contaminant sources including industrial effluent, sewage and landfill leachate. The most affected were the shallow aquifers lying under urban, industrial and agricultural development

Table 6: Groundwater contamination incidentsin Australia

Contaminant Source	Number of Incidents
Industrial effluent	32
Sewage	23
Landfill leachate	14
Petroleum products	13
Food processing waste	11
Mining	8
Agriculture	5

Source: *Groundwater contamination incidents in Australia: an initial survey*

13 Gülçin Karlik, M. A. (2001). Investigation of groundwater contamination using electric and electromagnetic methods at an open waste-disposal site: a case study from Isparta, *Turkey. Environmental Geology,* 725-731

The study brought out the extent to which groundwater was being polluted by the improper disposal of waste from various sources. The biggest concern associated with waste is leachate.

A study conducted on the main landfill of the city of Zagreb in Croatia to assess the extent of groundwater contamination caused by it revealed startling facts. The landfill contains around 5 million tons of waste (1998). Here, waste is disposed directly onto the alluvium sediments a few kilometers upstream of a large groundwater protected zone. The study was conducted to determine remediation methods for the landfill. Redox conditions in the aquifer remained anaerobic i.e. nitrate reducing even after a distance of 1200 meters from the landfill. The most alarming finding of the study was that water was contaminated by waste not only in the surface layer but up to a depth of 60 meters in to the aquifer.

Studies conducted in the Southeastern Wisconsin region of the United States in the late 1990s revealed a gradual decline in groundwater quality and increase in occurrences of polluted water. A large part of the waster-table aquifer in the region is contained within unconsolidated sediments in the upper bedrock. An inventory was prepared to evaluate groundwater resources and their potential for attenuation of contaminants. The study revealed a plethora of human activities contributing to increasing groundwater contamination. However, the largest sources of this pollution were from landfills, dumps and impoundments and from abandoned areas used for waste disposal. Man made sources of contamination below the surface included waste disposal in wet excavations. Of major contaminants found nitrate, landfill leachate and detergents were the largest contributors to groundwater quality deterioration. This particular study was conducted by the Southeastern Wisconsin Regional Planning Committee in cooperation with the Wisconsin Geological and Natural History Survey[14].

New Jersey is one of the most densely populated parts of the United States. A survey of groundwater and its quality was commissioned over three decades ago to prepare an inventory of its groundwater aquifers for toxic chemical composition. The area of New Jersey had over 16000 potable wells at the time of the survey in 1983. The survey revealed that of a total of 304 cases of groundwater contamination, 78% were due to the dumping of municipal and industrial wastes in the vicinity of water bodies. A further 37% of groundwater affected by improperly disposed waste became unusable until remedial action was taken. The study was conducted by researchers from the University of Pennsylvania[15].

14 Alexander Zaporozec, J. E.-O. (2002). *Groundwater Contamination Inventory: A Methodological Guide.* New York: UNESCO

15 Ruth Patrick, E. F. (1987). *Groundwater Contamination in the United States.* Philadelphia: University of Pennsylvania Press

Impacts of Improperly Disposed Waste on Health

Most Indian studies cited in this paper discuss only contamination of groundwater whereas global studies referenced in this paper discuss in detail impacts of the contaminants as well. Although the exact composition of waste differs globally, by and large type of waste disposed is similar. India bears the burden of unsegregated mixed waste while a large number of countries employ mandatory segregation. In such an eventuality, we are at a greater risk of contamination and health hazards due to disposal of mixed wastes.

The studies so far have detailed a plethora of impacts that various streams of waste have on human and environmental health.

Settlements around landfills are a very common feature across the world. The impacts of landfills are far-reaching and not only limited to the populous in the immediate vicinity of the site. There are a number of studies that have been conducted on effects of landfills on human health. Birth defects and reproductive disorders are a common result of living in proximity of landfills. A study conducted by M Vrijheid (2000)[16], revealed a multitude of impacts landfill exposure can have on human health. The most common landfill gases are carbon dioxide, methane and hydrogen sulfide. Sustained exposure to these gases in close proximity has been found to be a cause of low birth rate, fetal and infant mortality, spontaneous abortion and occurrence of various birth defects in pregnant women. Not limited to only exposure to gases, but dust and other particles, smoke, leachate run off and decomposition bear direct impacts on health. These include respiratory illnesses, toxic exposure, skin diseases, bone diseases, hair loss, nausea, vomiting, circulatory and nervous system disorders among others.

A major risk of open disposal of organic waste is that it ferments, creating conditions conducive to microbial growth and survival. Microbial contaminants found in groundwater include bacteria, viruses and parasites.

16 Vrijheid, M. (2000). Health effects of residence near hazardous landfill sites: a review of epidemiological literature. *Environmental Health Perspectives,* 101-112

Together these can cause diseases like cholera, typhoid fever, dysentery and hepatitis[17].

It goes without saying the dangers involved with exposure to hazardous wastes. Exposure to hazardous waste in landfills sites and otherwise raises the risk of cancer manifold. Liver, kidney and pancreatic cancer are also risks resultant from exposure to such wastes. A more common set of effects on human health include respiratory problems, fatigue, headaches, irritation of the skin, eyes and nose, psychological problems and allergies. Exposure to chemicals released during incineration impact the cardiovascular and respiratory mortality and morbidity. Reduced lung functioning and lung cancer are also risks caused by improperly disposed waste[18].

Common metals and contaminants found in groundwater and their resulting impact on human health has been summarized in the table below:

Table 7: Common metallic and other contaminants found in groundwater and their impact on human health

Contaminant	Impact
Cadmium	Kidney poisoning, genetic mutations, renal lesions. Group I carcinogen
Chromium	Lung tumors
Copper	Metabolic disorders
Lead	Abdominal and nervous system damage
Sodium	Heart damage
Antimony	Altered blood levels of glucose and cholesterol and reduced longevity
Arsenic	Acute and chronic toxicity, liver and kidney damage. Decreases hemoglobin and is a carcinogen
Barium	Cardiac, gastrointestinal and neuromuscular effects
Beryllium	Toxicity, damages lungs and bones.
Cyanide	Poisons spleen, brain and liver
Fluoride	Causes bone disorders and calcification of joints
Mercury	Toxicity. Damage to kidneys and nervous system disorders
Nitrate	Causes ‘bluebaby‘ disease

Source: *United States Geological Survey: Contaminants Found in Groundwater*

17 Survey, U. S. (2015, November 6). *United States Geological Survey (USGS).* Retrieved April 13, 2016, from United States Geological Survey Website: http://water.usgs.gov/edu/groundwater-contaminants.html

18 Ibid.

Conclusion

Waste poses a huge health risk because of its potential to contaminate ground water and the extent to which it actually does contaminate groundwater. Contamination of groundwater results in toxic water consumption, for drinking and all other purposes. Homo sapiens are not the only species affected by toxicity of water resources.

This study shows the number of, and the extent to which many chemicals and metals have been found in groundwater resources in different parts of the country. The presence of elements like cadmium, chromium, antimony, palladium, sodium, lead, mercury leads to life-threatening risks. Further, toxic elements like cytotoxins, aliphatics, terpeniods, benzenes, ketones, pharmaceuticals and phthalates further put populations at risk that happen to be users of water in which these chemicals are present.

These life-threatening elements and chemicals have been found in most underground water sources in the vicinity of landfills. Studies have not been conducted across all landfills in the country but the studies available paint a grim picture. In the absence of scientific engineered landfills this will continue to pose a threat to our demography.

The Indian government has for the first time placed such an urgent importance on sanitation through the Clean India Mission realizing the need to tackle this magnum opus problem. The following steps can be undertaken as part of the Swachh Bharat Abhiyaan (SBA):

- Minimize the quantity of waste being disposed at landfills
- Legislate the nature of materials that can be disposed in a landfill, such as inerts
- Ensure segregation of waste at source is mandatory
- Decentralize waste management for composting and diverting recyclables.
- Use the Extended Producer Responsibility (EPR) clause to enable producers to share responsibility for toxic household products.
- Ensure toxic household wastes not put into even hazardous waste landfills as

these too have a limited life and will finally pollute water

- Phase out waste dumps

The SBA has the ability to play a key role in helping reduce the current trend of groundwater contamination. A special focus has been laid on waste management and sanitation. Along with this, the Government of India has revamped and updated the rules for all types of waste in the country. These rules coupled with the tenets of the SBA can totally change the existing waste management scenario.

However, the solution to preventing ground water pollution is not polluting our air through toxic waste to energy technologies. By mandating waste reduction, segregation of waste at source, decentralized waste management, composting of organics, materials recovery and pushing for handling of toxic household wastes, a drastic reduction of toxicity is possible. This in turn will reduce the pollution of ground water, an irreversible outcome of poor waste management.

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