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Assesment of Occurence of Diseases Related to Ground Water Pollution in South Western Districts of Haryana

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Abstract

Ground water plays a vital role in human life. During last decades, it has been got observed that ground water get polluted drastically because of increased human activities.Consequently, increase in number of cases of water induced diseases has been seen which is a cause of health hazards.This paper examines occurrence of diseases related to ground water pollution in three south western districts of Haryana i.e. Hisar, Fatehabad and Sirsa. In order to have an assessment of occurrence each in water induced diseases/ health disorders, one month data were collected from five hospitals/ nursing homes of all the blocks of the three districts. Maximum number of cases were found for diseases caused due to fluoride pollution of ground water in all the blocks of three districts.

Keywords: Water Induced Diseases, Health Disorders, Fluoride, Ground Water Pollution etc.

Introduction

Water occurring either as surface or subsurface water is the mankind's most important, vital and versatile resource on the earth. Ground water is the major source for drinking water in both urban and rural areas (Gupta *et al*., 2009). Ground water is used for domestic, Agriculture and industrial water supply all over the world. More than 98% of the population in Haryana, India uses ground water as primary source of drinking water (Rout and Sharma, 2011). Increasing population and demands caused the deterioration of surface and sub surface water Dhiviyaa Pranavam et al. Most rural areas lack treatment facilities for drinking water.The effect of water pollution on human health is a serious issue (Rawat and Arora, 1986). Drinking water plays an important role in the intake of true elements by human. Fluoride is the main problem in the study area. Fluoride is essential for the formation of dental enamel and normal mineralisation of the bones (Ceopalan, 2003). However, excess fluoride increases the risks for cancer, heart disease, Down's syndrome, acquired immunodeficiency syndrome, osteoporosis and bone fracture, low intelligence, allergic reactions, and other health conditions (Hodge, 1986).

Objective of the Study

The study was aimed at assessing ground water pollution especially of fluoride and nitrate in the three south- western districts of Haryana in relation to land use i.e. agricultural, residential, industrial and commercial areas, and to examine possible relation of occurrence of various water-induced diseases in these areas.

Review of Literature

Varughese and Prasad (2012) carried out ground water quality analysis in the varahanadi basin. Ground water samples were analyzed for various physico-chemical parameters and compared with the standard desirable limits of water quality parameters prescribed by Bureau of Indian Standards and World Health Organization. It was observed that the bed rock of the study area influenced the ground water quality resulting in higher concentrations of calcium, potassium and phosphates in the ground water samples.

Ground water samples were collected from different aquifers in Sulaimaniyah city (Quaternary sediments and Kometan and Tanjero formations) and from different depths by Mustafa and Ahmad in 2008. Majority of the water wells (63% of the ground water in Sulaimaniyah city) were found to be polluted with nitrate. A study on fluoride contamination status of ground water in Phulera tehsil of Jaipur district, Rajasthan was carried out by Sabal and Khan (2008). After the pilot survey, symptoms of skeletal and gut fluorosis have been found in almost every inhabitant.The

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result revealed that the quality of ground water of Phulera was very poor, and was not suitable for drinking purpose and that it can only be used after proper treatment. Similarly, Das et al. (2012) examined fluoride in drinking water at various villages of Patripal panchayat, Balasore district. Most of the villages had higher concentration of fluoride than that suggested by WHO and BIS and most of the people were affected by fluorosis like dental fluorosis or skeletal fluorosis.

Study Area

Study area of the three districts i.e. Hisar (Hisar city, Hansi, Narnaund, Uklana, Barwala, Agroha, Adampur block), Fatehabad (Fatehabad city, Bhuna, Tohana, Jakhal, Ratia, Bhatthu block) and Sirsa (Ding, Sirsa city, Nathusari chopta, Rania, Ellenabad, Oadan, Kalawali, Baragurha, Dabwali block) districts, Haryana. **Hisar**, the west central most district of Haryana, with a total geographical area of 4050sq.km lies between the north latitudes 28^o 56': 29^o38' & east longitudes 75^o 21': 76^o 18'. **Fatehabad** is bounded by 28^o48'; 29^o17' north latitudes and 76^o28'; 77^o12' east longitude covering an area of 2490 sq.km. **Sirsa**, the north western most district of Haryana state with a total geographical area of 4270 sq km lies between 29^o 13':29^o59' north latitudes and 74^o30':75^o7' east longitudes (CGWB, 2007).

Assessment of Occurrence of Diseases

Various health problems or diseases associated with ground water pollution are found to occur in the study area. In order to have an assessment of occurrence each in 15 such diseases/ health disorders, one month data was collected from five hospitals/ nursing homes of all the blocks of the three districts as shown in tables from 3 to 5.

Amongst various toxic substances, fluoride was one of such chemicals present in high concentration in ground water of some of the pockets of south western Haryana, which can pose several typical health risks like dental carries, dental fluorosis, skeletal fluorosis and some risks of generalized nature like sterility problem and gastro-intestinal problems. An attempt has been made to examine the actual cases of such health problems in the three districts of the study area.

Dental Caries

It is an infection, bacterial in origin, that causes demineralization and destruction of the hard tissues (enamel, dentin and cementum), usually by production of acid by bacterial fermentation of the food debris accumulated on the tooth surface. Due to excess fluoride, these hard tissues progressively break down, producing dental caries (cavities, holes in the teeth). One month data showed that 4-16% patients of the total visitor patients in one month are suffering from dental carries in various blocks of Hisar distrct, 2-10% in various blocks of Fatehabad district and 3-23% in various blocks of Sirsa district. Dabwali in Sirsa district reported maximum number of cases where 23% patients were found affected.

Table 1

Occurrence of Diseases Related To Ground Water Pollution in Different Blocks of Hisar District

Sr. no.	Name of disease	Age Group (Years)	Hisar City (% affected)	Hansi (% affected)	Narnaund (% affected	Barwala (% affected)	Uklana (% affected)	Agroha (% affected)	Adampur (% affected)
1.	Dental carries	5-20	16	4	7	5	7	6	9
2.	Dental fluorosis	15-35	18	6	5	6	9	4	12
3.	Skeletal fluorosis	40-60	10	-	2	-	4	-	5
4.	Low hemoglobin levels	> 10	14	11	13	8	13	13	20
5.	Gastrointestinal problems	15-35	20	9	14	10	12	11	14
6.	Abdominal pain	20-45	22	12	19	13	17	14	16
7.	Urinary tract malfunctioning	30-45	9	-	4	-	6	-	7
8.	Male and female sterility	25-35	7	-	-	-	2	-	3
9.	Blue baby syndrome	-	-	-	-	-	-		-
10.	Cardiovascular system affected	-	-	-	-	-	-	-	-
11.	Central nervous system affected	35-50	-	-	-	-	-	-	-
12.	Ulceration	35-45	-	-	-	-	-	-	-
13.	Gastrointestinal and bladder cancer	40-50	-	-	-	-	-	-	-
14.	Hypertension	35-60	17	11	9	12	7	5	9
15.	Kidney and bladder Stone	30-50	9	10	7	4	1	3	8

The data has been collected from 5 hospitals/ nursing homes in each block in the month of December, 2012.

Dental Fluorosis

The mineralization of teeth under formation may be affected in dental fluorosis. Dental fluorosis reflects an increasing porosity of the surface and subsurface enamel, causing the enamel to appear opaque. The clinical features represent a continuum of changes ranging from fine white opaque lines running across the tooth on all parts of the enamel to entirely chalky white teeth. In the latter cases, the enamel may be so porous (or hypomineralized) that the outer enamel breaks apart posteruptively and the exposed porous subsurface enamel becomes discolored. A larger proportion of population in various blocks of Sirsa district showed dental fluorosis namely Dabwali (39%), Sirsa city (13%) and Ding (12%), Hisar district also showed that 4-18% patients were affected by dental fluorosis and the cases were low in Fatehabad district (3-12%).

Skeltal Fluorosis

Fluorine enters the body by two paths: Ingestion or respiration. Both paths lead to corrosion of exposed tissue in high concentrations. Since the most likely form of fluorine to enter the body is hydrogen fluoride (HF) gas, this is what starts the process. Exposed tissues are utilized by HF in neutralization reactions. This leaves F^- free to pass

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further into the body. It reacts with the concentrated HCl in the stomach to form the weak acid, HF. This compound is then absorbed by the gastro-intestinal tract and passes into the liver via the portal vein. Since F is the strongest oxidizer known at present, it is immune to phase 1 metabolic reaction, which is generally oxidation reactions, in the liver. These reactions are the body's first line of defense to biotransform harmful compounds into something more hydrophilic and more easily excreted. The HF is now free to pass into the blood stream and be distributed to all tissues including bones. Bones are largely composed of Ca compounds, particularly carbonated hydroxyapatite (Ca_{10} $(PO_4)_6$ $(OH)_2$); the reaction of Ca and HF forms an insoluble salt, CaF_2. This salt must be cleared by the body and as a result washes away some of the calcium that would be part of the bone matrix. This process results in increased density, but decreased strength in bones. All districts showed lowest reported cases of skeletal fluorosis. Cases of skeletal fluorosis that occurs mostly in age group of 40-60 years, again maximum occurrence was in Dabwali block (17%) followed by Sirsa city (8%) of Sirsa district.

Male and Female Sterility

Though sterility is a health problem that could be due to several reasons, the toxic effects of fluoride causing male and female sterility are reported in literature. In males the reproductive toxic effects include increases in numbers of abnormal spermatozoa, loss of spermatogenesis, interference with steroidogenesis, dramatic increase in abnormal, mutated sperm. In females fluoride causes repeated miscarriages and still births since the fetal arteries calcify arresting the growth of the fetus. Fluoride ingestion also leads to anemia in pregnancy and low birth weight babies. Relatively greater proportion of such cases of sterility in Sirsa City were (9%), Hisar city and Dabwali, both were (7%), incidentally the same pockets that show greater incidence of fluorosis points towards possible role of high fluoride concentration in ground water of these areas that lead to such problems.

Table 2

Occurrence of diseases related to ground water pollution in different blocks of Fatehabad district*

Sr. no.	Name of disease	Age Group (Years)	Fatehabad City (% affected)	Bhuna (% affected)	Tohana (% affected)	Jakhal (% affected)	Ratia (% affected)	Bhatthu (% affected)
1.	Dental carries	5-15	10	5	7	3	5	2
2.	Dental fluorosis	15-45	12	9	6	4	3	4
3.	Skeletal fluorosis	40-60	8	3	-	-	-	2
4.	Low hemoglobin levels	> 10	20	13	9	4	8	11
5.	Gastrointestinal problems	25-50	17	11	12	7	7	15
6.	Abdominal pain	20-50	16	16	15	5	13	12
7.	Urinary tract malfunctioning	30-45	7	6	3	-	3	4
8.	Male and female sterility	25-40	4	-	-	-	1	-
9.	Blue baby syndrome	-	-	-	-	-	-	-
10.	Cardiovascular system affected	-	-	-	-	-	-	-
11.	Central nervous system affected	35-50	-	1	-	2	-	-
12.	Ulceration	35-45	-	-	1	-	-	-
13.	Gastrointestinal and bladder cancer	-	-	-	-	-	-	-
14.	Hypertension	35-65	17	14	9	7	10	13
15.	Kidney and bladder Stone	30-60	13	9	6	9	7	10

*The data has been collected from 5 hospitals/ nursing homes in each block in the month of December, 2012.

Gastrointestinal Tract Disorder

It is a health problem that could be due to several reasons; the toxic effects of fluoride causing gastrointestinal tract disorder are reported in literature. Ingested fluoride is transformed in the stomach to hydrofluoric acid, which has a corrosive effect on the epithelial lining of the gastrointestinal tract. Thirst, abdominal pain, vomiting, and diarrhea are usual symptoms. Hemorrhage in the gastric mucosa, ulceration, erosions, and edema are common signs. 9-20% patients in various blocks of Hisar district, 7-17% in various blocks of Fatehabad district and 5-34% patients out of total patients during one month in various blocks of Sirsa district were found affected.

Methaemoglobinemia or Blue Baby Syndrome

Ingestion of compounds containing nitrates (such as the patina chemical bismuth nitrate) can cause meth moglobinemia. Infants less than 6 months of age are particularly susceptible tomethemoglobinemia caused by nitrates ingested in drinking water (called blue-baby syndrome). Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body in infants of six months old or younger, dehydration usually caused by gastroenteritis with diarrhea, sepsis, and topical anesthetics containing benzocaine or prilocaine. Instead of being red in color, the arterial blood of met-Hb patients is brown. This results in the skin of caucasian patients gaining a bluish hue. Though, NO_3^- concentration in ground water was found to be high in some areas of the three districts. But, no reported cases of blue baby syndrome were found in the medical records of hospitals/ nursing homes of the blocks in these districts.

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Table 3
Occurrence Diseases Related To Ground Water Pollution in Different Blocks of Sirsa District*

Sr. no.	Name of disease	Age Group (Years)	Sirsa City (% affected)	Ding (% affected)	N. Chopta (% affected)	Rani (% affected)	Ellenabad (% affected)	Oadhan (% affected)	Kalawali (% affected)	Baragurha (% affected)	Dabwali (% affected)
1.	Dental carries	4-15	11	7	10	3	3	9	11	4	23
2.	Dental fluorosis	15-45	13	12	9	-	5	7	7	-	39
3.	Skeletal fluorosis	40-60	8	7	-	-	3	-	-	-	17
4.	Low hemoglobin levels	> 10	26	21	14	12	18	13	12	14	29
5.	Gastrointestinal problems	15-45	34	24	17	-	16	11	15	5	23
6.	Abdominal pain	20-45	36	17	23	16	19	20	19	10	20
7.	Urinarytractmal functioning	30-45	11	9	4	-	5	3	7	-	9
8.	Male and female sterility	25-35	9	5	-	-	-	3	-	-	7
9.	Blue baby syndrome	-	-	-	-	-	-	-	-	-	-
10.	Cardiovascularsy stemaffected	-	-	-	-	-	-	-	-	-	-
11.	Central nervous system affected	35-50	3	-	-	-	-	-	-	-	4
12.	Ulceration	35-45	4	2	-	-	-	-	-	-	2
13.	Gastrointestinal and bladder cancer	40-50	1	-	-	-	-	-	-	-	1
14.	Hypertension	35-60	24	12	8	17	14	9	13	21	11
15.	Kidney and bladder Stone	30-50	13	2	12	2	-	-	11	10	9

*The data has been collected from 5 hospitals/nursing homes in each block in the month of December, 2012

Ulceration and Gastric or Bladder Cancer

Nitrate ingestion may be linked to gastric or bladder cancer. The most likely mechanism for human cancer related to nitrate is the body's formation of N-nitroso compounds, which have been shown to cause tumors at multiple organ sites in every animal species tested, including neurological system cancers following trans placental exposure. Nitrite, the reduced form of nitrate, reacts in the acidic stomach to form nitro sating agents that then react with certain compounds from protein or other sources such as medications to form N-nitroso compounds. In humans, it is the nitrosamines and N-nitroso compounds that are suspected brain and central nervous system carcinogens. In the study area NO_3^- seems not to pose a risk of this type as such cases were absent in all the three districts except 1% cases in Sirsa city and Dabwali.

Kidney and Bladder Stone

It is a health problem that could be due to several reasons; the toxic effects of calcium of ground water causing stone formation are reported in literature. Homogeneous nucleation occurs when calcium and oxalate ions complex to form small crystals that then grow to larger pure calcium oxalate stones. Heterogeneous nucleation occurs when calcium and phosphate ions complex to initially form small crystals of calcium phosphate. These small crystals form the substrate upon which calcium oxalate subsequently deposits. This results in a mixed calcium oxalate-calcium phosphate stone. 1-10% patients in various blocks of Hisar district, 6-13% in fatehabad district and 2-13% patients in various blocks of Sirsa district were found affected.

Hypertension

When individuals consume high salt diets or water with higher sodium content, their bodies retain water because of this chemical attraction. The extra water then increases the total blood volume in the body, causing blood pressure to increase. In healthy individuals, the body is able to excrete the extra salt and water to normalize blood pressure. Five-17% patients in various blocks of Hisar district, 7-17% patients in various blocks of fatehabad district and 8-24% patients in various blocks of Sirsa district were found affected.

Preventive Measures to Control Ground Water Pollution

As ground water is frequently used for the abstraction of drinking water, for industry and for agriculture, ground water pollution can endanger human health. Once contaminated, ground water is harder to clean than surface water and the consequences can last for decades. Ground water pollution occurs due to natural

and anthropogenic reasons. Ground water gets contaminated due to see page from industrial wastes and agricultural runoff. Natural ground water pollution cannot be controlled but anthropogenic ground water pollution can be controlled at source level.

Control at Municipal Level

1. Sanitary sewers are intended to be watertight. There should be no leakage of sewage into the ground because sewer leakage can introduce high concentrations of BOD, COD, nitrate, organic chemicals and bacteria into ground water.
2. The sewage should be suitably treated before releasing it into water.
3. Liquid waste originating at domestic level, industrial level and storm runoff should be properly treated before its discharge into surface water which is recharged into ground water.
4. The land disposal of solid wastes like sanitary landfills is an important source of ground water pollution. So land filling for solid waste management should not be adopted.

Control at Industrial Level

1. The major uses of water in industries are for cooling, sanitation, manufacturing and processing. Industrial plants should discharge their waste waters after proper treatment in ETP's, ponds, pits, or lagoons.
2. Leakage from tanks storing wide variety of fuels and chemicals and pipelines can become a source of ground water pollution. There should not be leakage of such products into the ground.
3. Water extracted from mines can cause ground water pollution. Therefore this water should not be discharged into ponds before treatment because this water may be highly mineralized.
4. Water released by industries as effluents should be recycled.
5. Industrial effluents should be recycled, discharged after treatment or dumped at sites that are at a safe distance from residences, agricultural areas and water bodies.
6. Some non-toxic wastes of biological origin can be used in agricultural fields as fertilizers.

Control at Agricultural Level

1. Excessive use of fertilizers should be avoided because nitrogen, phosphorus and potassium rich compounds enrich the ground water and cause ground water pollution and irrigation return flows can be the major cause of ground water pollution in fertilizer rich areas.
2. Pesticide residues can be significant in agricultural areas as a diffuse source of ground water pollution. Use of more stable pesticides should be banned as far as possible and less stable pesticides should be used in a judicious manner.
3. Animal wastes may introduce salts, organic loads, and bacteria into the soil. This type of waste should be properly disposed.

Miscellaneous Prevention Measures

1. Chemical status of ground water should be assessed.
2. Indirect discharges (after percolation through soil or subsoil) of pollutants into groundwater should be prevented and limited.
3. Liquid wastes should not be discharged and stored onto ground surface in an uncontrolled manner because it can migrate downwards to degrade ground water quality. The ground surface must be lined with some impervious material to prevent leaching of pollutants into ground water.
4. Solid wastes materials are frequently stockpiled near industrial plants, construction sites and agricultural fields. Precipitation falling on these stockpiles causes leaching of salts, heavy metals, inorganic and organic constituents as pollutants to the ground water. That's why solid wastes should be properly discharged.
5. Polluted surface water bodies that contribute to ground water recharge become sources of ground water pollution. Surface water pollution should be controlled.
6. Proper knowledge about ground water pollution should be given to common man, so that he can help in controlling it.
7. There should be well-defined legislation to control ground water pollution.

Conclusion

Ground water was found to be influenced by high concentrations of TDS, total hardness, bicarbonates, sodium, sulphate, nitrate and fluoride. To assess the occurrence of diseases/ symptoms associated with these ground water pollutants, a survey was conducted by collecting the one month data from local doctors and the nursing homes/ hospitals of the study areas. Many cases of dental carries, dental fluorosis, stones, high blood pressure and some cases of skeletal fluorosis, ulceration and intestinal cancer were reported. Preventive measures to control ground water pollution at various levels were also suggested.

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References

1. C.G.W.B., 2007. Report. Central ground water board, Ministry of water resources Government of India. North western region, Chandigarh.
2. Ceopalan C., 2003. The Changing epidemiology of malnutrition in developing society. Current Science, 77, p. 1257.
3. Dhiviyaa Pranavam T.S., Venkatesa Rao T., Punithavathi L. Karunanithi S. and Bhaskaran A., 2011. Ground water pollution in the Palar Riverbed near Vellore, Tamil Nadu, India. Indian J. Sci. Technol., 4 (1): 19-21.
4. Gupta D.P., Sunita and Saharan J.P., 2009. Physiochemical analysis of ground water of selected area of Kaithal city (Haryana) India. Researcher., 1(2): 1-5.
5. Hodge, H.C., 1986. Evaluation of some objections to water fluoridation. In: Newbrun E (ed). Fluorides and dental caries. 3rd ed. Springfield, IL: Charles C Thomas, 221-55.
6. Rawat, N.S. and Arora, R.K., 1986. J, Mines, Metals and Fuels, 112.

7. Rout C. and Sharma A., 2011. Assessment of drinking water quality, A Case study of Ambala cantonmentarea,Haryana,India.InternationalJ. Env.Sci.,2(2):933-945
8. Das, K.K., Panigrahi, T. and Panda, R.B. (2012). Occurrence of fluoride in ground water of Patripal panchayat in Balasore district, Odisha, India. J. Environ. 1(2): 33-39.
9. Mustafa, O.M. and Ahmad, H.S. (2008). Nitrate pollution in ground water of Sulaimaniyah city, Kurdistan region, Ne Iraq. Iraqi. Bullet. Geol. & Minin. 4(2): 73-82.
10. Sabal, D. and Khan, T.I. (2008). Fluoride contamination status of ground water in Phulera tehsil of Jaipur district, Rajasthan. *J. Environ. Biol*. 29(6): 871-876.
11. Varughese, S and Devi Prasad, K.V. (2012). Physico-chemical analysis of ground water samples in the varahanadi watershed, India. *Intern. J. Env. Sci*. 2(3): 1662-1669.