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IMPACT OF CHEMICAL CONTAMINATION ON SURFACE AND GROUNG WATER RESOURCES IN SUB-HIMALAYAS AND LESSER – HIMALAYAS THROUGH ROCK AND SOIL LEACHATES AND UNTREATED WASTE DISPOSAL IN WATER : Waterborne Diseases A Case Study

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Abstract: The contamination sources in Sub-Himalayas and Lesser-Himalayas are landfill leachates , waste disposal from hospitals, sewage from hospitals, homes, cities, leakages from under ground septic tanks, waste material dumped on ground surface, chemicals from agriculture, pesticides, effluent from chemical industries, the soils and rocks. The main source of river water is melting of glaciers on mountains. The second source is rain water. The rain water percolate in soil and get excess to aquifer. People get this water for drinking through springs. The water coming through rocks leach chemical [hazardous toxic]elements and absorb gases , like Ca, Mg, K, Na, CU, Pb, Mn, CU, Zn, Hg, Ar, SO_4, CO_3, NO_3, NO_2, CO_2. and contaminate drinking water. Similarly, the water coming from soil as springs is used for drinking. Alternate sources are ponds, lakes and rivers. Contamination of water is an international problem. As a case study 500 water samples were collected from springs, Nalas, lakes, ponds, rivers, rock and soil leachates and tested for routine and toxic hazardous elements. The leachates contamination is a big risk for health. The toxic elements move to ground water and contaminate surface water. The samples collected were analyzed for chemical contamination of water in Himalayas. In addition more than 100 patients were selected for blood tests and 1000 reports were thoroughly investigated for water borne diseases. It was found that in those areas where water is contaminated, 15% patients get cancer, 25% heart diseases, 20% stomach pains, 10% neurological problems, 40% bone diseases, 10 % intestine injuries, 20 % neurological

system failure. The parasite giardia lamblia, identified in 30% cases. Viral in 15%, bacterium E-Coli in 7%. In the outbreak of E-Coli 40 % peoples were hospitalized and 20 % died. Five hundred people were ill with severe intestinel distress, other flue like symptoms, weakness, aches, and pain. At least 4000 people were died from 2012-2021. More were HIV positive. The disease was treated as cryptosporidium. The chemical and microbiological agents adversely affecting the quality of ground and surface water. Waste disposal from hospitals, land applications, animal wastes, septic tanks, sewage, organic wastes, toxic hazardous wastes leachates and petroleum products affect water quality in the area of study. Chemical contamination in stream water anf spring water exceeds the recommend limits.

The WHO Guidelines [2001-2021]. Guidelines for water are Cd < 0.03 mg/l, Hg 0.001 mg/l, Pb < 0.01 mg/l, As < 0.01 mg/l, Cr < 0.05 mg/l, CN < 0.07 mg/l, NO3,NO2 <50 mg/l, Zn < 5 mg/l, CU < 1 MG/L, Cl < 250 mg/l. The chemical values in Azad Kashmir and Punjab Pakistan are higher than recommended values.

INTRODUCTION

The surface and ground water contamination in Sub -Himalayas and in Lesser Himalayas is mostly due to waste disposal from hospitals, sewage from homes, rock and soil leachates, in study area. The role of hydrogeology of the area is very important. Some contaminants do not interact with geologic materials. They travel at a long distance. The leachates which do interact do not travel farther [Li et al. 2020]. Leachates contaminated water when travel in permeable materials where ground water velocity is greater. In Himalayas due to land complications leachates can not travel more than a few hundred meters from the source [Aziz HA, Umar M, Yusoff MS, 2010]. In some cases contamination is localized. It was found that in areas where land use is wide spread, contamination cover large area. Toxic decay elements have also been found ground and surface water. The water contamination from Septic tanks is 20% landfills, leaking 10%, underground tanks 12%, mining rocks and soils 13%, untreated hospital waste disposal 25%, sewage water from homes 5%, liquid industrial wastes 15%, oil fields 5%, Municipal waste14%, water sewage, and disposal of animals waste 9% are main sources contributing to the contamination. In the area of study siwalik rocks are well exposed and bearing uranium traces. The rocks are highly fractured. The water is coming from fractured rocks. The rocks were investigated by AEC [Atomic Energy Comission] in past for utilization of uranium sources. The researchers found traces of Uranium in rocks. They closed the work as source was not economical. In the same rocks it was found that baseline water quality showed somewhat elevated level of natural uranium activity due to natural leaching of uranium bearing rocks by water moving along fracture system [Baun DL, Christensen TH, 2004]. The people of the area use the same water for drinking purposes. A detailed study was conducted to investigate the water borne diseases in the area. It was found that > 65% peoples were affected by toxic hazardous elements like uranium. The neurological problems, cancer, Skin diseases, stomach pains and blood diseases are common in the area.

Geologically, the rocks are: surficial deposits, colluvium-recent, Alluvium, Sandstone, shales, mudstone, Kuldana F, shales, and calcareous sandstone. Margala Hill limestone, Patala F. shales and Abbottabad F., Dolomite. Hazara Formation slates are present in study area. All these rocks absorb water and leach out. The rocks are highly fractured and jointed and leachates moved to ground water and contaminate surface water.

The rocks contain hazardous and toxic elements like, Ca, Mg, Na, K, Cl, Fe, Mn, CU, Pb, Cr, Se, F, . leach to ground water at shallow depth, moving in an aquifer near water table [Baun et al, 2004]. There are some streams, Nalas and rivers flowing through rocks. The water leache rock elements and transport them from one place to another. New deposits are formed. The transportation of elements and leachates contaminate ground water as well as surface water. In Neelum and Jhelum valley where rocks bearing Pb and Fe are well exposed. The leaching of toxic elements during wet season surface and ground water are highly contaminated through leachates. The ground- water in Mong area is highly cancerous due to presence of uranium traces. In Rawalakot surface and ground water is mainly contaminated by waste disposal on ground, the sewage waste water, hospitals wastes, and drainage system [underground copper an iron pipes]. Microbiological decay of organic compounds also contaminate surface and ground water. In Neelum valley Landfills, Mining of lead, iron, carbonate rocks, transportation of building material, stone quarries and leaching of carbonate rocks in rainy season, contaminate surface as well as ground water. More than 20% springs and 50% surface water is contaminated by leachates and untreated waste disposal on surface. 30% contamination is due to microbiological decay. The main source is the hospital waste generation recoded as infectious waste or non - infectious waste. Average daily hospital waste is between 300 – 1000 kilo each. The waste of Rawalpindi Cantonment area is 100 ton / day [data collected from Contonment Board, Committee on Appropriate Disposal of Hospital Waste, 1995-2021]. The serious issue of the waste is the disposal of solid waste, chemical waste, and radioactive waste. The chemical waste is most dangerous. There is no disposal site for drugs, gases, solvent and the radioactive waste is mainly iodine 123, iodine 131 and thallium 201. There is no sites for biological, chemical, radiological, nuclear, medicine waste with any administration [unpublished report public health, 1984]. It was seen that children were playing with syringes. The infectious waste is more dangerous to health i.e culture and stocks, human blood and blood products, animal waste, unused sharps, pathological waste, syringes, and isolation waste. Non -infectious waste include solid waste, chemical waste, all radioactive waste [public health unpublished report 1984-2021]. All this is dropped directly in water or on the ground without any treatment. No site has been developed for waste disposal in study area. The waste from industries is directly dropped in water, experience from Lai Nala streams, Sawan river.

At least 25 million people are lacking clean water in study area. There are no proper sanitation system. Five to ten thousand people died from water borne diseases during 1997-2007. At least 20 million people face water shortage. Five to six rivers are highly contaminated with waste disposal in water. Growth rate 50% increasing every year. About 0.01% peoples can avail facility of freshwater. Water shortage is due to limitations on availability of resources, capacity of resources, and the added value of available water [Borquaye LS, Ekuadzi E, Darko G, et al, 2019]. Management of agricultural land is related to water. Millions of people from rural populations are employ with agriculture. Effective water resources can be used for poverty elevation of poors. The following shows toxic effects of heavy metals in water:

Heavy metal	Potential Toxic Effects
Pb	Anaemia, Cancer, Renul Kidney disease, Nervous system damage, Mental retardation, Behavioural problems in children
Cr	Severe Diarrhea, vomiting, Congestion liver, Kidney damage
Cd	Damage to Kidney, Cancer, Bronchotis* Emphysema, Skeletal damage, fibrous
As	Skin Cancer, Lungs bladder and Kidney Cancer, other internal Tumers, vescular distress, Diabetes, infant mortality, weight loss, heavy loss reproductive toxicity hexatologic Disorder, neurological diseases, Abnormality, Neurobehavarioral diseases
Hg	Damage to Kidney, Reproductive system immune hematologic cardiovascular, Brain.
Zn	Stomach Nausea, skin irritations, cramps, vomiting, anemia.
Ni	Dry cough, Bones, nose and lung cancer, cyanosis of breath, tightness of chest, chest pain Nausea, vomiting, Dizzininess, head ache.
CU	Increased, blood pressure, damage kidney and liver, convulsions, vomiting, death.

[Ihsanullah et al. [2016].

Requirement of water /day 7700000 gal /day

Available 350000 gal /day

One home / day requirement of water is 2700 gal/day.

Islamabad –Rawalpindi are not cleaning water to satisfactory level and allow microbes to go to undetected [WBCWRAS, EPA 2005]. No serious initiative has ever been taken to address this issue. The water in twin cities is unhygienic due to bacteriological contamination. Bacteriological contamination is in distribution network and at filtration plant in Rawalpindi and Islamabad . Punjab has lower quality of water due to widespread contamination [microorganisms] as revealed by several studies [Mashiatullah et al, 2010]. 20% to 40 % loads in Pakistani hospitals occupied by patients suffering from water borne diseases including cholera, diarrhea, dysentery, hepatitis. Typhoid, and 1/3 of them are died [Pak-SECA, 2006, Farooq et al 2008]. Now it is ½. Terry, 1996 reported that 1.5 billion people lack safe water. At least 5 million deaths /year attributed to water borne diseases in under developed countries. Heavy metals in water directly related to health [Onsdroff 1996]. [table-1].

[Population Welfare Department]

Research and development efforts be made and appropriate technologies for water saving from contamination be made, for crops that consume less water be cropped, effective water and waste water treatment plants and water reuse methods be employed.

METHOD OF STUDY

At least 500 samples were collected from springs and selected waste disposal points. One thousand samples were collected from streams, rivers, Nalas tape water and selected waste water disposal points. To evaluate chemical contamination, the samples were immediately transported to PCSIR, RCD laboratories Karachi and WAPDA SCARPE monitoring laboratory Lahore. In 1998-2021. Microbiological study of water resources and waste water samples were analyzed in public health engineering Division of Mayu Hospital Lahore, EPA, PCSIR Karachi. High level equipments were used to determine chemical elements and biological organisms. Organic and inorganic both contaminants were given special consideration. Especially the elements involved in water borne diseases were emphasized.

1. For study of PH, PH -meter was used in the field.

2. Chromatography, Spectrometry, Potentiophotometry and Atomic Absorption were used for toxic metals determination .

Table: 1 Showing Toxic Hazardous Trace Elements from the springs and streams in the area under study

Mn	B	Fe	Cu	Pb	PO4
43	2	44	-	1.5	7.8
55	90	24	1.5	1.6	130
34	26	95	10.5	6.2	9.5
55	95	52	9.2	5.9	85
70	80	50	35	8.8	45

LOADS

The highest suspended load in stream water coming from rocks as leachates and waste disposal is about 18000 g/l, hardness 350-96 mg/l, alkalinity 156-98mg/l, TDS 660-100 mg/l, E C at 25 c, 600-300 , TSS 25000-250, cat ions 8.0-1.5 mg/l, anions 6.0-2.2 mg/l. . Ca 69-23 mg/l, Mg 60-4.5 mg/l, Na 5.0-0.61 mg/l,HCO3 98-30 mg/lCl 98.8-30.0 mg/l, SO4 179-28.9 mg/l. The underground water contains Ca 70-28 mg/l, Mg 70-14 mg/l, HCO3 200 mg /l , Cl 155-25, mg/l, SO4 70-25 mg/l. The common rocks in the area are sandstone, shale, carbonates. The silicon in the rocks is 40% in sandstone, 30% in shales, and 3% in carbonate rocks. Units used: Turbidity NTU, Color: TCU, Taste and Odor: TON [Table-2].

Table-2. Showing load of Leachates in stream water in Sub-Himalayas and Lesser –Himalayas in study area

Hardness	Alkalinity	TDS	EC 25C	TSS	Cat ion
350-96 mg/l	156-98 mg/l	660=100 mg/l	600-300	25000-250	8.0-1.5mg/l
Ca mg/l	Mg mg/l	Na mg/l	HCO3 mg/l	Cl mg/l	SO4 mg/l
69-23	60-4.5	5.0-0.61	98-30	98.8-30.0	179-28.9
Load of	chemical	Elements	On	Stream	Water
Ca mg/l	Mg mg/l	K mg/l	CU mg/l	Pb mg/l	Cr mg/l
70- 0 -28 .0	70-14	60.8-2.0	36.0-1.6	>8.9	40.0-0.8
Fe mg/l	PO4 mg/l	SO4 mg/l	-	-	-
94.1-23.0 ug/l	149-5.0 UG/L	160-15.0 Ug/l			
Load of	chemical	Elements on	Spring	Water	
Ca ug/l	Mg ug/l	K ug/l	HCO3ug/l	C lug/l	SO4 ug/l
77-45	45.23	38.1-2.9	185-37.1	160-15.0	55-20.6
dHardness meq/l	Alkalinity meq/l	TDS	EC 25C	TSS mg/l	
266	155-52	>555	579x10	>200	
Water demand in Rawalpindi-Islamabad					
180 million gal/day					
Water borne diseases Hepatitis	Cases reported 5000 cases	/year			
Dihrrahea	50-60 %	/m			
Gastro	60-70%	/m			
Dysentry	34-40%	/m			
Biological contamination	85 %				
Physicochemical	20%				
Hardness	5.0%				
Total coliform	9%				

Load on Pakistani Hospitals *

	60% to 70% patients are water borne diseases	Load 60-70% patients are admitted /y		Pakistani	No of Hospitals visited 45						
	Waterborn diseases	Patient percentage					water	Sources			
	Cholara	69%					polluted	Coliform			
	Diarrhea	45%					E-coli	PCRWR 2006			
	Dysentery						Farooq				

							et al, [2008]				
	Hepatitis										
	Typhoid										
	1/2 of them are died			Pak-SECA-2006							

[Farooq et al 2008]

Table-3. showing Chemical Analysis from stream water, spring water, Landfill and Rock Leachates in study area] mg/l

Si%	Al	Fe	Mg	Ca	Na	K	Mn	Cr	CU	Pb	Co	PO4	
35.5	5.8	4.6	2.2	3.7	2.8	3.2	10.25	112.	70.8	23	8.5	12.5	Sandstone
33.0	12.7	6.5	3.0	4.0	23.5	4.0	98.0	50.0	14.7	21.0	2.5	0.9	Shale
2.9	3.5	4.3	7.5	40.5	2.2	3.5	98.0	18.20	8.0	8.0	2.0	5.0	Carbonate

RESULTS

ground water in relation to water borne diseases have been evaluated. Chemical weathering is important in weathering chemical elements and transportation from one place to another. The chemical weathering transform one mineral to another and Sometime completely dissolve the mineral. All chemical weathering depend on the presence of water. Hydration probably is important chemical process, is the reaction between mineral and H+ and OH- ions of water. The clay minerals and Zeolite [[micro poros alumino silicates] may form by weathering of minerals, such as Si, Na, Po4, Ca, and Mg. Continued driving of the reaction requires removal of soluble materials by leaching, complexing , adsorption, and precipitation. Leaching by carbonic acid [H2CO3], the PH system, Chelation, Cation exchange, [cause replacement of hydrogen, colloids that influence the clay minerals, permeability], oxidation, carbonation and microbiological effects. Photosynthetic bacteria cyanobacteria, blue green bacteria leach the rocks and soils [Christensen TH, Kjeldsen P, Bjerg PL et al, 2001]. In Rawalpindi –Islamabad 4000 cases of hepatitis were recorded due to unfit drinking water. 40%-51 % gastro, 47%-59 % diarrhea, dysentery, 28%-38%, hepatitis A, 32%-38%, B, 16%-19%, C, 6%-7% were recorded [Farooq et al 2008]. The water demand in Rawalpindi-Islamabad was 172 .8 million g/d in 2008 [EPA, WBCWRAS, Farooq et al, 2008, Mashiatullah et al, 2010, Anwar et al, 2010]. Now it is 4 fold. Recently evaluated percentage of patients is higher than the past calculation. New investigation indicate 12000 cases of hepatitis recorded in the year 2021-2023 due to unsafe water. 60-70% gastro. , 75-60 % diarrhea , dysentery 84%, hepatitis A 85%, B 48%, C 18%. In some cases it is more [Table – 2].

Table- 4 Showing Order of Weathering of Rocks and Soils and mineral transformation in the study area

	Soil/Rock group	Advance weathering, kaolinite Gibbsite, hematite Anatase
Gypsum, halite, sodium nitrate Calcite, dolomite applite Olivine- hornblende[pyroxene] Biotite [glauconite, nontronite] Albite [anorthite, micro cline,orthoclase]	Soil dominated Fine silt and clay Desert soils Limited weathering	Intense rains erode and run off where light intensity long duration rain aid in leaching
Chemical weathering high at lower latitude Chemical weathering , moderate	Dry place In hot semi dry area	Chemical weathering active in rainy season In hot wet humid ,tropical area

[Fadhullah W, Kamaruddin MA, Ismail N et al, 2019].

If the moving water transporting led with oxygenated water in the ground or ground water emerges in

rivers and streams, iron, manganese, and sulfide oxidation results and carbonate precipitation occurs [DN C C, 2016]. Later it can leach to water. The alkaline earth [Ca, Mg, alkalies, K, Na, Li,], low PH colloids, more easily contaminate ground water. Silica-alumina leaching to kaolinite. Mg, Ca, and Fe, are formed in low electrolyte, low PH. Most kaolinite is formed from feldspar, and micas by acid leaching of acidic rocks. The leaching is also through low PH, acidic environment in wet season human activity, and weathering conditions [Rock and mineral stability] [Table-4].

DISCUSSION

Contamination of water sources in Sub-Himalayas and Lesser-Himalayas is wide spread. No treatment plant have been found in the area of study. The chemical industrial waste which is dropped in river Sawan, streams and Lai Nalas without treatment is about 50-100 tons /day. The sewage from homes, hospitals, industries, open in Lai Nala [surface water]. It was reported in 1995 by a research team who were appointed by Government of Pakistan for examine waste disposal facilities in cities and hospitals. They reported that hospital waste dumping in Lahore , only in one city, the quantum of this waste is over 10 tons / day. The Mayo hospital have more than 2000 beds and 500 operations / day have been conducted, they have not even one incinerator functional[Unpublished reporte Waste Disposal research committee 1995]. A special survey was conducted for examination of solid and liquid waste disposal facilities in hospitals, cities, villages, and water contamination by waste disposal, leachates from rocks and soils, sewage system in the area and environmental education. Water sampling and chemical analysis of samples from solid wastes, sewage water, spring water, Nalas, stream and river water and chemical analysis of rock samples were emphasized. Main chemical waste generators are:

Heavy metals	Sources
Pb	paints, pesticides, smoking, auto mobile emelsions, burning of coal, mining
Cr	industrial waste water, discharge of environment, cooling tower blow down, Electroplating, metal plating, and cooling operation
Cd	steel and plastic industries, cooling tower blow down, electro plating, metal

	Coating operations, Ni-Cd batteries, Cd-Tc thin film solar cells, pigments, Z-n galv anized pipes, welding fertilizers, nuclear emission.
AS	Pesticides, fungicides, sedimentary rocks, geothermal wastes, weathered vol Canic rocks, mining, manufacturing, metallurgy, wood preparation.
Hg	mineral deposits, fossil, pesticides, batteries, paper industry,
CU	pesticide industry, wood pulp production, mining, metal piping, chemical Industry.
Zn	bron plating, wood pulp production, ground and news prints, paper Production, steel works, galvanizing, lines zinc and brass, metal works Refineries, plumbings.
Ni	battery manufacturing, production of alloys, zinbase casting, printing, Electroplasting, silver refiniries. [Table-3].

1. Hospitals most important places producing contamination, infectious waste include cultures

And stocks, pathological waste, human blood, blood products, sharps and syringes, animal waste, isolation waste, unused sharps. are not properly discorded but they are dumped on the ground or in Nala,s water. The non -infectious waste that is the solid waste which is danger to human life is also not properly disposed, but dropped on open ground near water source. There is no policy and procedure for hazardous chemical spill plane. The hospital waste disposal management is based on day to day handouts issued within the hospital. There is no collection system, material is collected by sweepers, only four hospitals have incinirators in working conditions [Research Committee , 1995-21]. It was noted that hospital waste is dumped in open area. Average daily hospitals waste is between 100-1000 kilo each. Total waste is 100 tons / day, in 1995. now it is 150 tons / day [Research Committee, 1995, 2021].

2. From the rock leachates the chemical constituents have been found , which are: Pb , Hg Ca, Mg, Zn, Cu, Mn, Fe, Cr, As and other dissolved chemical constituents of the rocks. In wet season leachates from all sources were recorded which contaminate water sources.
3. Most of the leachates are coming from mining areas, as mining of lead, phosphate, limestone, gypsum, iron gold, copper, zinc, manganese which are most health hazardous .
4. Leachates from solid wastes have recently been studied in villages and cities.
   [Committee on Appropriate Disposal of Hospital Waste, 1995]

Sixty villages and 15 main cities were thoroughly investigated. In cities water tanks, filter plants, sewage system, solid and liquid waste disposal sites, hospitals and their solid waste disposal sites were investigated for contaminants. From Rawalpindi: It was recorded that Lai Nala, Sawan river and small streams are highly contaminated. All the disposal wastes are dropped in surface water. Even the cities wastes and sewage water drained in Lai Nala. Adjacent schemes and colonyes and villages waste is also dropped in surface water. All Nalas and river water was thoroughly analyzed. There is no Hospitals, waste disposal sites in the study area. Water tanks, distribution sites, treatment plants are connected with underground water pipelines which ultimately linked with sewage pipe lines and contaminate drinking water. Similarly, from Rawalakot, Bagh, Plandri were investigated for water contamination sources. Medical investigation committee reports were thoroughly checked, blood samples and their reports were investigated to know the surface and ground water contamination and water borne diseases in the area. It was found that hospitals were loaded with patients drinking unsafe water [Table-4].

ANALYSIS

Naturally occurring substances such as decaying organic matter can move in ground as leachate, soluble liquid decaying particles, all this depend on prevailing conditions. Some of them are health hazard. Some are undesirable and produce unlikely taste, odor and not used for drinking. In Azad Kashmir and Pakistan most contamination is outflow from septic tanks. Chemical used in agriculture, animal waste burial, Improper disposal of hazardous waste, surface impoundments are unlikely.

Vulnerability of water is due to effects of groundwater contamination. The diseases like hepatitis, cholera, giardiaso, methemo -globinemia, and blue baby syndrome have been identified. Vulnerability of water is classified as 25% excellent, 20% good, 16% doubtful, , 45% unsuitable. The order observed is cd> Zn> Cu> Ni>Pb . For adult Cd > Cu>Ni>Zn>Pb [Encyclopiedia Britannica, 1960].

Water quality index was calculated by Wi = W1/ W1+W2 where WI is relative weight, W1= weight of each parameter. Qi = Ci - C0, where Ci = constant ratio of each parameter, C0 is the ideal value.

WQ = < 50 excellent, 50-100 good, 100-200 poor, 200-300 very poor based on WQ1. [DNCC, 2016].*

Toxic metals are hazardous to environment and health. Chemical elements found , both in surface and ground water. The toxic elements , Zn , Pb, Hg, Cr, Cd, Se, As, are poisonous. Some are micronutrients at lower doses [Hashim , et al 2011]. Hexavalent Cr6 + can increase the risk of cancer [He and Li, 2020]. Arsenic is ranked as a group-1, human carcenogene [US, Environmental port. Agency and EPA]. As+3 can react with sulphydryl [SH] group of protins and enzymes to upset cellular functions and eventually cause cell death [Abbas et al, 2018, Rebelo and Coldas 2016]. Toxic metals also bioaccummulate enter the food chain and ultimately enter the body through food [He and Li 2020, Hashim et al 2011].

Organic contaminants have been found in water regarded as carcenogene disrupting chemicals. In groundwater > 200 organic contaminants have been found and this number is still increasing [Lesser et al,2018, Jurado et al, 2012, Lapworth et al, 2012, Sorensen, et al, 2015. Some organic contaminants bio degradable while some are persistent. Biodegradable originate from domestic sewage and industrial waste water. Many of these are naturally produced from carbohydrates, proteins, fats, and oils. The nitrogen contaminants such as nitrate, nitrite, ammonia, nitrogen are inorganic contaminants. Nitrate is predominantly from anthropogenic from anthropogenic sources, including agriculture, and domestic waste water [Hansen et al, 2017]. Ground water contamination through nitrate has been widely reported from regions covering Azad Kashmir and Pakistan. Most of inorganic contaminants found in groundwater are anions and oxyanions like F- , SO4--, and Cl-, and major cations Ca 2+, Mg2+, TDS, total amount of inorganic and organic legends in water. These contaminations are natural [Adimlla and WU, 2019].

Daily average vegetable intake = 0.345 kg /person /day for adult. The health risk index [HRI] was calculated using HRI= DM / Rfd where DI = daily intake of metal and Rfd = reference oral dose estimated / day. Daily intake of metal =C metal xCfactor x Dfood intake/ B average weight,

Landfill : The leachate from different sources make Trihelomethane* [T H M], toxic for human health. The leachate produce Pb 9 mg/l, Cd, 3 mg/l, Cr 3.2 mg/l, Cu 5.5 mg/l, Ni 56 mg /l. The biotic organic compounds : Aromatic hydrocarbons, micro-plastic , xenobiotic /emerging contaminants [Alam et al, 2020].From table -3 it seems that all toxic hazardous elements are > than the recommended limits in surface and ground water.

For leachates heavy metals in plants:

Spinacia aleracea, Brassica aleracea and Solanum lycopersicum common in the area. HRI for adult heavy metal consumption by vegetable [Pb, Cd, Mn] > 2 mg/l which is very high. In some places like CMH, Kamsar, and Rawalakot , Bagh and Plandri HRI, in food and plants Pb > 6-8.9. exposure through food, vegetables, cause anemia, weakness, kidney and brain damage. Cd is highly toxic carcinogenic that is harmful to most of the bodies systems [Hutton, 1967, Jahon et al 2016, Kamal et al 2016, Alam et al 2020]. For Ni, 2-8 is neurotoxic and carcinogenic for human [Genchi et al, 2020]. Ni also exert toxic effects on plant growth. These toxic elements restrict the growth of plant roots, stems and leaves[Pollord , 2016].

Cancer Risk: [Table-4]

Table-4 showing Cancer Risk in study area through Drinking Water and vegetables grown near landfill

CR	Muzaffarabad	Rawalakot	Plandri	Bagh	
Ni intake> 1x10-4	high	high	high	high	
Pb > 3.32 x10-4-8.7x10-3	VH	VH	VH	VH	
Cd > 3 x 10-3-5.1x10-3	VH	VH	VH		VH

AZIZ HA, Umar M, Yusoff, M.S, [2010],

CONCLUSIONS

Ground water contamination impact human health, environmental quality and socioeconomic development. High level of fluoride, nitrate, metals, and persistent, organic pollutants are health risk. Blue baby syndromes infant methemo – globinemia by excessive nitrate [He et al, 2020, WU and Sun, 2016].

PAHs and PCBs are common contaminants of anthropogenic origin in groundwater and cause serious health problems.

Natural occurring substances, Ar, Fe, Cl, SO4, F dissolve in water. Decaying of organic matter can move in groundwater as particles posing health threat.

Pesticides and fertilizers is a huge source of contamination. Spreading of fertilizers , pesticides, fungicides, insecticides, herbicides and animal waste on the land is a big source of contamination. Nitrates and bacteria seeping into ground water sources and stay in ground for many months or year fell congenital disabilities, cancer, and low sperm counts in humans.

Waste from sewers, and pipelines seep into groundwater. Soils consist of organic matter, heavy metals inorganic salts, bacteria, viruses, and nitrogen . improper waste disposal leak bacteria, viruses, chemicals and contaminate groundwater i.e the improper disposal of hazardous wastes. Salt water , landfills, military bases, and atmospheric contamination all are hazardous to health.

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