



CONSEQUENCES OF AGRICULTURAL CHEMICAL CARCINOGENIC ELEMENTS IN WATER AND ENVIRONMENTAL POLLUTION IN PAKISTAN AND AZAD KASHMIR IS A CAUSE OF CANCER. A CASE STUDY:

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Abstract;

The carcinogenic elements in agricultural chemicals, pesticides and indoor and outdoor environmental pollution cause cancer. The cancer causing carcinogenic elements are: Pb, Cd, Ar, Ni, Hg, Br, Cu, Zn, Mn. The Pb in water is 4.0 to 9.1 affect nervous system and red blood cells, reduce in cognitive development. The Cd is 1.5 to 7.9 > WHO and EPA affect renal tubular function, high risk of lungs and breast cancer. As 2.0-5.0 effect dermal, respiratory and nervous system and is > EPA and WHO limits. The Ni is 1.9 - 4.6 mostly linked with dermtotoxicity, lower body weight and fetotoxicity among pregnant women. Hg is higher than WHO and EPA 3.1 - 3.9 and effect cardiovascular system, reproductive and developmental toxicity, nephrotoxicity, immune-toxicity and carcinogenicity. The Cr in water is 2.5-5.6 > WHO and EPA and hazardous to health. The carcinogenic elements come from waste water, industrial wastes, environmental pollution, agricultural chemicals, pesticides, mining, dust, fog, Tobacco and beverages are Pb 1.3 > WHO. As 1.9, Cd 1.5, CO 0.5, CU 0.6, Hg 0.8, Ni 1.9, and As 2.1 > the WHO and EPA recommended limits. The fast food intake, fruits and vegetables, generate inflammation and generate glucose, pro inflammatory liquid level, dyslipidemia to autophagy inhibition generate carcinogenesis. Non availability of technology, poor hygiene, poor handling of food, addition of pond water in milk,

addition of methanol, addition of urea and sugar in milk, unapproved food addition, cleanings products, like octyl phenol is a cause of cancer.

Carcinogen in spring water Pb 0.8 - 9.2, the Cd 1.5-8.0 is > WHO and EPA limits and is a cause of cancer in the locality. Ni 0.8- 9.1 is > WHO and EPA recommended limits. These carcinogen attack DNA and damage cells. DNA may lead to creation of genes. Genes give cells. The genes uncontrollably become cancerous, tumor or blood cancer. It take long time in development. The contact with carcinogen there are many ways daily or life time as: using tobacco, workplace using carcinogenic chemicals, virus [Hunan Papilloma virus HPV], cause cancer, long time exposure to carcinogen, genetic inherited mutation is a health risk. NTP [National Toxicology Program], reported 63 carcinogenic substances. 193 substances may cause cancer. Most recent 122 substances known to cause cancer [IARC]. 93 substances that probably cause cancer. 319 substances may cause cancer. Biological carcinogen as infections from viruses, bacteria, parasites, beverages containing alcohol. Alcohol is a NTP known carcinogen cause head and neck, liver, esophageal cancer. Tobacco products like smokeless, and second hand smoke tobacco use is leading cause of cancer WHO, EPA, ASCR. Ultraviolet rays from sun may cause skin cancer. Radon is colorless gas inside buildings, business schools, own home is a cause of lung cancer. Asbestos NTP exposure to human is a cause of lung cancer, Formaldehyde in the work place is high risk of leukemia and rare cancer in their nasal cavities and sinuses. The sources of environmental pollution is due to carcinogenic elements like Hg, Pb come from gold mines contaminate local produced grains and vegetables. The Hg and Pb exceed WHO limits and is a potential health risk. The Pb and Cd mostly come from iron mines. Cd concentration in livestock and grains is higher than WHO limits. In Sindh Villages near chemical industries, coal fields [Tharparker and Nagarparker] and in Azad Kashmir animals near mines and water contamination found above maximum level [90%]. The MRL is 60. Environmental pollution [Pb, Cd, Cu, Zn] contaminate crops. The concentration of carcinogenic elements in vegetables, foods, exceeded from WHO and EPA limits. As 2.0-5.0, Cd 1.1-1.6, Pb 3.4-4.7, Cr 2.5-5.6, Fe 88.2-167.9, Hg 3.1-3.9, Mn 35.6-140.8 mg/kg. The concentration from all sources is > WHO recommended limits.

INTRODUCTION

A survey was conducted in 1996- 2023, during research in Punjab, Sindh, and Azad Kashmir for drinking water contamination. The surface and groundwater was analyzed in PCSIR Karachi and EPA Islamabad. some samples were analyzed in University of Karachi in Geochemistry Laboratory on Atomic Absorption for carcinogenic elements. The vegetables were tested in Agricultural University Sindh, Fasilabad and Punjab. Previous data was collected from published literature available. Daud et al, 2012, Somro et al, 2011, Thair et al, 1998, HE et al 2016, indicated carcinogenic elements in vegetables, fish and drinking water. Khan et al 1996- 2023 worked on drinking water of Rawalakot, Muzaffarabad and Plandri and published papers. The industrial waste water which is chemically polluted, the agricultural chemicals, pesticides, containing carcinogenic elements, the environmental pollution, indoor and outdoor contamination directly affect human health and increase risk of cancer [EPA, WHO, 2002]. The outdoor pollution in air is the dust, burning of wood and grass, industrial exhaust, mining activities, fog in air are Carcinogen in our daily life [ASCR, EPA, WHO, 2002-2023], are as browned and crispy foods, sun light, processed meat, tobacco, long time exposure to carcinogen, tobacco products, ultraviolet rays, radon, asbestos, formaldehyde Bisphenol, alcohol, are risk for cancer [ACSR, WHO, EPA, 2015, 2022], Arfins et al, 2015, Ahmed et al 2015, Akpor et al 2014.

Browned and crispy foods: cooking starchy foods in a way that cause them to brown could create carcinogen [ASCRC, Research Council 2023]. This include frying potatoes, toasting bread, and roasting coffee. High heat brown our food and formation of a new product acrylamide [ASCORU, 2024]. ASCORU [2024] indicate that when acrylamide in animal study give acrylamide in high dose [higher than normal human consumption] increase cancer risk. The sun light and ultra violet rays affect human health [UVR]. The exposure to sun rays boost skin cancer risk [ASCOR 2024]. The processed meat: a cold cut sandwich can hit the spot [ASCOR, 2024]. Those processed meats contain carcinogen and are health risk are preserved with chemicals like Nitrates, and Nitrites. When they are cooked at high heat converted to a product polycyclic amines and heterocyclic amines which are carcinogenic [ASCORU, EPA, WHO 2024]. Tobacco which is common in our society is the leading cause of cancer. Tobacco create lung cancer, throat cancer, esophageal cancer, colon and bladder cancer [ASCORU, 2024]. The radon is a odorless and silent gas that naturally produced in rocks and soils [Adimalla et al 2019, Alam et al 2000]. It makes its way in to water and the air of enclosed spaces without ventilation [ASCORU, 2024].

Radon exposure increases risk of lung cancer [ASCO, WHO, EPA, 2024]. The cancer risk also increases from air pollution. Bisphenol [BPA]. BPA is a chemical found in water bottles to canned foods, Tupper ware. It can leaked to food stored in those products. It increase risk of breast and prostate cancer[ACORU, EPA, WHO, 2024, Abbas et al 2016]. Alcohol in drinks, mouth wash, medication, concentration of it is the risk of liver, breast, esophageal cancer[ASCORU, 2024]. The ASCORU, 2024 indicate that BPA damage DNA can cause hormones increase estrogen level which increase cancer risk. Carcinogen change DNA [ASCORU,2024]. The cells that repair DNA damaged and can not work and left DNA unrepaired. DNA change to genes which create cells. Cells spread in excess create tumor, blood cancer, but it take long time to develop [ASCOR, 2024]. Aesthetic engagement with nature--- air quality ---CANCER---Water Hazard Mitigation---Water Quality are important tools for cancer risk. . The Bio concentration Factor was calculated by using equation [Imtiaz et al 2021]

Imtiaz et al 2021 uses the Formula for calculated daily intake of vegetables per person and carcinogen which increase in body of a person.

$$BCF = C_{\text{plant}} / C_{\text{soil}}$$

Estimated Daily Intake : [Imtiaz et al, 2021]

$$\text{The intake of vegetables is calculated using} = EDI_{\text{veg}} = \frac{C_m \times C_f \times F_{ir} \times E_f \times D_e \times 10^{-3}}{W_b \times T_{av}}$$

Where C_m is metal concentration mg /kg of dry weight

E_f = exposure frequency = 365 days /y

D_e = exposure duration = 70 y, T_{av} = average time of exposure = 365 days x 70

F_{ir} = average food consumption = 300-350 g / per person/ day

By WHO mean of this consumption = 325 /115 g / person / day

C_f = conversion factor of vegetable of dry weight [0.085]

W_b = average body weight of consumer 70/ 15 kg

The carcinogen in vegetables collected from Muzaffarabad, Rawalakot, Mirpur, Rawalpindi, Lahore, were analyzed. The results for carcinogen are as:

Table-1: Carcinogenic elements in water, vegetables in big cities of Pakistan, Cauliflower, Potato, Carrot, Pumpkin, Green peas, Tomato, onion, Brinjal, Cabbage, Garlic, Beetroot, Bitter Ground, Corn [Khan et al 2024, Imtiaz et al 2021].

As 1.9, Cd 1.5, CO, 0.5, CU, 0.6, Fe, 1.0, Hg, 0.8, Mn, 1.1, Ni, 1.9 ----- Pb, 1.3, Zn, 1.0, As, 2.1, Cd, 1.1, Cr, 0.8,	Cancer Risk: High HCR
Local: Azad Kashmir. As 0.8, Cd 1.2, CO 0.3, CU 0.6, Fe 1.2, Hg 0.7, MN 0.8, Ni 0.5, Pb 0.6, Zn 1.5, Cr 0.9	HR

Imtaiz Ashraf, Fizan Ahmed, Atif Sharif, Adnan Raza Altaf, Haipeng Teng [2021, Khan et al, 2024]

The amount of carcinogen increases in human body from three sources 1, from soil, 2, from drinking water, 3, from intake of food like vegetables, fish, meat, grains from weight, rice, tobacco, beverages, from environmental pollution, ingestion etc.

MATERIAL AND METHOD:

The water samples were collected from selected places from streams, Nullah, Rivers, Ponds, tap water, ground water from springs, borings, and at drilled places. The samples were analyzed in PCSIR Karachi and University of Karachi. Atomic Absorption, electron microscope, Spectroscopy were used to detect carcinogenic elements. The hazardous carcinogenic elements detected are: AS, Cd, Co, CU, Fe, Hg, Mn, Ni, Pb, Zn, As, Cd, Cr. Daud et al, 2021 studied for the Environmental pollution. Published literature was studied and from published papers relevant data was collected and used for reference. The data was also collected from hospitals, and other relevant places. The published literature was used as reference and data was also compared with our research data to know the most hazardous carcinogenic elements. Blood data was collected from number of patients daily registered in hospitals and the details were noted.

Recently cancer is so common in our country that every second person is involved in cancer. Safety is important for human health in the resident places. The food, milk, water all are contaminated. Vegetable almost used daily by peoples living in the area. Vegetable coming from Pakistan. The places where vegetables are grown mostly near chemical industries and leachates. The industrial waste water, effluent form industries used for vegetables growth. The leafy vegetables absorb carcinogenic elements. The environmental pollution add more carcinogen in vegetables. The soils also increase carcinogen in vegetables. Vegetables are one of many sources for cancer. The contaminated drinking water, the use of fruits, indoor contamination, radon gases, outside sun rays, cooking foods in irrelevant ways, the processed meat, sea food all are highly contaminated due to environmental pollution, soil, and chemically polluted waste water. All beverages and food increase carcinogen in human body parts like bones, lungs, heart, and create neurological and cancerous problems [Daud et al, 2021, Borquaye et al 2019, Genchi et al, 2020].

Daud, M.K. Nafees, M, Ali, s. Rizwan, M., Bajaw, R. A., Bilal M., Shakoor M.B., Arshad M. U., Ali S., Chatha S., Deeba F., Murad W., Ijaz M., Jin Z. S.

Table:-2. Indoor and out door carcinogen in daily life in food, surroundings, exposure to sun, radon, non ventilated buildings, processed foods, cooking starchy foods, tobacco and its products, use of cooking stoves, use of gas [ASCR, EPA, WHO, NPDWR, NESHXAP,NTP, PSOA, 2024].

COMMON INDOOR POLLUTANTS. CO, Radon, Pesticide, Dust, mites Pb, Smoke Bacteria, Bioaerosols	Cooking starchy foods in a way that causes them to brown	Cloud create carcinogen	Include frying potatos, toasting bread, roasting coffee	High heat that brown our food to inflamation of a substance called acrylomide	In animal study in USA by [ACSRT 2024], acrylamide in high dose higher than normal human consumption	Increase cancer risk	It is recommended to cook food on low heat or yellow color.
Sun light/ultraviolet rays	Impossible to avoid	Lot of time in sun	Increase risk of skin cancer				
CARCINOGEN	Chemical substances	Environment al radiations	Lifestyle behaviors	Medications	Pollutions	Viruses	HPV, Hepatitis C
CLASSIFICATION [NTP] National	US Department of Health	HHS [2024] and IARC	Five classification	GP1 proven carcinogen	GP2 A Probably carcinogeni	GP2B Possibly carcinogen	3 Unclassifiable

Toxicology Program	and Human Services			ic human to	c to human	ic human to	4 Unlikely
How to protect	1-Read labels	2- follow the directions for handling and storage chemicals	Consider using alternative products , such as natural home cleaners	Avoid using tobacco	Limit your alcohol intake	Use sunscreen	Avoid residence without good ventilation
Short effects of carcinogen	Eye irritation	Nasal itching	Throat rashes	Asthma	Bacteria growth	Respiration of heart	Diseases
6% people affected due to unhealthy fuel use	Lung Cancer risk in adults has been reported	In Pakistan using unhealthy fuel living rooms with attached kitchens	Produced as child mortality of about 145 Deaths/1000lives birth	Houses using clean fuel as separate kitchens Have 10 deaths/1000	80 deaths /1000 Due to indoor kitchen fuel , women > affected	Mail affected less	Use of clean fuel reduce indoor health hazards
2.4 MILLION PEOPLE WORLDWIDE 1/3 OF GLOBAL POPULATION USE OPEN FIRE AND STOVES FUELED BY BIOMASS	WOOD, ANIMAL DUNG, COAL, KEROSENE FOR COOKING	These burns activities produce several harmful indoor air pollutants	The indoor air pollution responsible for > 4 million deaths/ y including over 2 million deaths of children	Under 5 year. Effects of indoor pollution observed in the form of > 6 million premature deaths/A	Led to diseases such as pulmonary infactions, lung cancer, strokes, heart diseases, chronic	Lung diseases. Women and children > effected by indoor cooking activities caused great	Health effects. EPA ref IAQ within and around buildings indoor pollution cause major risk to public health

[American Society of cancer, 2015, Diesel Exhaust and Cancer Risk, DEC ,2022, NPDWR, NESHXAP, NTP 2024.PSOA, PSOF 2024, Hansen et al, 2017, Hiromi et al 2023]

RESULTS

The carcinogen from industrial waste water, hospital wastes in water, home waste water, agricultural chemicals, pesticides, environmental pollution , all contaminate fruits, vegetables, sea food, grains. The ingestion of food and water, vegetables increase carcinogen risk in human body and affect different parts of the body [Imtiaz et al, 2021, Islam et al, 2014, Jarup et al, 2009]. The heavy metals like Pb, Fe, Hg, CO, Mn, Zn, Cr, Ni, Cu, As, and Cd in water soil, and vegetables and their estimated daily intake [EDI]. [Imtiaz et al [2021].

$$CR = \frac{EF \times ED \times IR \times C \times C_{sf}}{BW \times AT} \times 10^{-3}$$

BW X AT

Where CR = target cancer risk, EF = annual exposure frequency 365 days /year, ED = Exposure Duration 70 years for adult, IR = Ingestion Rate g /person / day , which is 130 g/ day / person for vegetable = 44.7, for fruit , rice = 367 g / day / person. Water Ingestion = 2 L / day / person

e = fish ingestion rate = 49.5 g / day / person, C= metal concentration in food mg / kg , Drinking Water = mg/l, BW = Body Weight = 60 KG for adult. AT = Average Time = non concentration =365 days / year, I = number of exposure year = 70 years , C_{sf} = oral carcinogenic = scope factor = obtained from the integrated risk information system [

USEPA], data base which was 1.5, 0.0085 and 0.38 mg / kg /day for As, Pb, Cd. Imtiaz et al [2021], [Arfins et al , 2015. Ahmed, et al, 2015, Akpor et al, 2014, Alam et al, 2020].

Table:-3 showing health risk from area under study [Rawalpindi, Mirpur, Muzaffarabad, Rawalakot, Khan et al [1996-2023]

HHR	Pb	Fe	Cd	Mn	Zn	Ni
0	2.0	0.5	1.5	0.9	0.1	2.2
1	3.7	3.5	4.0	1.9	4.0	2.2
2	2.5	2.5	2.5	4.2	2.5	4.5
3	1.5	3.6	1.2	2.8	3.1	3.2
4	0.2	4.1	2.6	3.1	2.9	2.2
5	3.1	5.2	4.9	4.8	3.9	3.1

[Sustain Dev. Bangladesh 10-1016/ JGSD, 2019100311. Khan et al 2023, Arfin et al, 2015, Ahmed et al, 2015, Akpor et al, 2014, Alam et al 2020. Imtaiz et al, 2021, Khan et al 2023].

Requirment of water in big cities

Muzaffarabad 12500000 g/day, Available = 370000 g/d. One home / day requirement 25000g /d

Mirpur = 15700000 g/d Available = 5 80000 g/d One home / day requirement = 30000 g/d

Rawalakot 118000000 g/d Available = 270000 g /d One home / day requirement = 25 000 g /d

Rawalpindi = 172.8 million g/d

WATER QUALITY INDEX = WQI = $W_i = \frac{W_1}{W_1 + W_2 + W_3} \dots$ WQ = < 50 Excellent . 50 - 100 Good. 100 - 200 poor. 200 - 300 very Poor based on WQi

Daily average vegetable intake are= taken as 0.345 and 0. 232 kg / person / day. Daily intake if metal D I M = Oral Dose = C metal x C factor x , Food = mg / kg , WA food intake/ Beverage Weight , where C metal = heavy metal concentration in plants mg / kg , C factor = conversion factor 0.085 x food intake reference oral dose Rfd estimated / day.

Reference Values for :

Pb 0.004, Ni = 0.02, Cu = 0.04, Cd = 0.001, Mn = 0,03, Cr = 1.5, Fe = 0.7, Zn = 0.30 mg / kg /BW / da CR =[EFX ED X IR X C X C sfo X] X 103 / BW X AT

Where CR = Cancer Risk , EF= Annual Exposure frequency = 365 d /y, ED = Exposure Duration = 70 y, IR = Ingestion Rate = g /person / day = 130 g / day / person for vegetable = 44.7 g / day / person Fruit = 367 g / person /day , Rice = 367 g / person / day . Drinking Water = ingestion = 2 l / day / person. Fish ingestion rate = 49.5 g / day / person C = metal concentration mg / kg, Water = mg/l, BW = Body Weight = 60 kg for adult.

Table: -4. Concentration of Toxic Metals in Stream Water in locality under study [Khan et al 1996-2023]

Location	Pb	Cu	Ni	Zn	Mn
Kanaparat	1.2	1.5	3.0	1.4	i.9
Baikh	3.6	3.9	2.8	4.0	4.5
Chotagala	4.2	1.5	2.7	2.9	3.8
Khaigala	4.2	1.8	3.9	4.1	4.8
CMH	9.2	2.6	4.6	6.1	6.8
Tarar	3.5	2.0	1.9	2.8	4.2
Banjosa	0.8	0.7	2.3	3.1	2.8
Dhamni	1.5	2.3	2.9	2.0	1.2

Table:- 5. Concentration of Toxic carcinogenic Heavy Metals in springs, Drinking Water in localities under study [Khan et al 1996-2023].

Location	Pb	Cu	Zn	Mg	Hg	Ni	Mn	Na	K	Fe	CL	N O ₂	SO ₃
Kanaparat	2.1	1.2	1.8	16.7	2.1	2.9	2.0	18.2	3.5	1.5	-	1.2	45.2
Shamas abad	2.8	1.6	2.1	17.5	1.5	1.9	3.6	20.4	2.1	1.6	-	2.3	45.8
City R.Kot	5.6	2.3	1.8	35.8	1.9	2.1	3.5	22.6	3.1	2.1	0.5	2.7	40.8
Kherik	2.5	1.9	2.0	23.6	2.8	2.7	3.5	40.5	1.8	0.7	-	2.3	46.8
CMH	2.3	2.1	1.6	15.7	1.8	1.8	1.7	20.8	3.2	1.5	-	3.1	46.8
Dewan	5.1	3.1	1.9	30.5	1.87	2.3	2.1	21.8	1.9	1.2	-	3.2	45.8
Trar	1.8	1.5	2.1	30.5	1.8	0.8	1.2	18.4	1.9	1.5	0.2	2.1	48.8
Khaigala	2.5	2.5	1.67	23.5	2.0	0.9	2.8	18.7	2.3	2.1	0.3	3.5	49.5
Burmang	1.8	1.2	1.82	20.3	1.8	1.3	1.9	15.2	2.8	2.8	0.6	1.8	54.8
Ali Sojal	2.3	2.9	2.6	26.6	2.3	3.2	2.7	25.6	2.9	1.7 9	-	5.6	43.8
Jabuta	2.1	2.4 5	2.8	35.6	1.8	2.4	1.8	18.6	1.9	3.2	-	2.3	48.7
Dothan	1.5	3.2	4.2	29.2	1.62	2.9	2.3	23.5	2.1	2.8	-	4.2	48.6
Chtagala	2.7	4.6	5.6	30.7	2.2	3.5	3.1	42.1	3.8	3.1	-	3.2	50.2
Hajira	4.3	3.9	4.8	40.6	3.5	2.8	3.8	46.7	3.9	2.8	-	4.2	55.5
Abbaspur	3.2	2.8	3.8	41.8	2.9	3.2	2.8	44.2	2.6	3.3	-	3.7 9	43.8
Muzaffarabad	5.9	4.9	4.4	60.6	5.2	4.9	3.3	48.9	4.7	5.8	3.8	5.6	50.8
Kotli	3.8	2.7	3.9	55.8	4.7	3.6	2.8	66.7	5.2	4.9	4.2	4.9	52.1
Mirpur	4.7	5.2	2.3	42.9	3.8	2.3	1.8	62.3	3.9	2.7	2.3	3.3	51.8
Rawalpindi. Frooq et al, 2008							Kha n	et al	19 96	202 3			
[Frooq et al 2008]	coli	E- coli	Location	Coli	E- coli	Isla mab ad	Pb	Hg	As	Cr	Co	Cu	Zn
Rawalpindi- Islamabad	74%	41 %	Sawat	80	76		1.2	2.0	2	2.6	2.	5.6	4.7
City	36.6 7	35. 5	Sindh	83	83	City	2.1	1.8	1.7	2.5	2.2	5.7	3.2
Rawal Lake. Frooq et al, 2008	100	66. 6	Hyderab ad	93	93		2.6	1.9	2.1	1.8	0.8	4.7	5.2
Water Filtration plant	40.6	25. 0	Karachi	86	86		3.9	3.2	3.7	2.6	2.5	5.6	6.8
Bahawalpur	60	8.0	Gawdar	67	70	80	82	Pb	Hg	As	Cr	cu	Zn
Fasilabad	46	46	Khairpur	100	100	100	100	2.5	1.8	2.7	3.9	4.6	5.2
Gujranwala	64	36	Rohri	100	100	100	100	2.9	3.2	2.8	2.8	4.9	4.3
Gujrat	56	56	Khuzdar	91	82	95	90	1.9	2.3	1.8	0.9	3.7	1.9
Kasur	40	42	Zariat	100	100	100	100	3.1	3.1	2.8	2.3	2.2	3.9
Lahore	85	85	Khyber Agency	100	80	100	95	2.1	-	0.8	1.0	4.9	2.2
Daud et al [1996- 2023] M. town	69	42	Bottled water borne diseases	37	37	40	40						
Lahore Southren	75	75	80% diseases	33% death s	To wate r	dise ases	49	1.2	-	2.1	1.9	4.6	3.8

				related	borne								
Multan	56	25				60	45						
Rawalpindi	100	75	100	95									
Tube well	53	33	68	50									
Filtration plant	53.8	53.8	60	55	Khan	etal		1996	2023				
15 Tube Well near nala lai	93	93	100	100	Pb	Cd	Ar	As	Ni	Hg	Co	CU	Zn
Rata Imral	75	75	90	90	1.3	2.7	1.8	2.6	1.5	0.9	1.1	2.8	3.6
Trench Bhata	100	89	100	100	2.1	1.6	-	2.1	1.2	0.8	1.2	4.6	2.1
Westrage	100	100	100	100	2.6	1.5	0.5	0.8	2.3	1.2	0.8	3.1	4.2
Sheikhanpura	45	27	59	55	1.5	1.8	0.9	1.8	1.4	0.8	0.5	3.8	5.7
Sailkot	70	50	90	90	1.8	1.9	0.7	0.66	1.6	0.7	-	3.5	4.7
Wah Cant	67	67	85	82	2.8	1.6	1.2	1.3	2.1	0.9	-	4.6	3.9
Abttoabad	55	36	60	60	2.8	0.6	0.5	1.5	2.1	0.7	-	2.6	2.8
Banu	85	86	90	92	-	-	-	-	-	-	-	-	-
Charsadda	100	100	100	100	2.8	2.6	1.8	1.8	2.1	1.6	0.7	5.2	6.1
Noshera	77	46	80	79	2.1	0.2	1.2	0.8	2.3	0.1	-	3.8	4.1
Noshera tube well	17	17	42	34	-	-	-	-	-	-	-	-	-
Kohat	64	64	80	83	1.3	1.6	0.7	0.4	1.3	0.8	-	4.0	2.5
Mardan	83	83	95	93	2.6	2.3	0.5	1.2	3.6	0.4	-	5.1	4.9
Urban Area	95	95	40	42	-	-	-	-	-	-	-	-	-
Peshawar	62	38	85	85	-	-	-	-	-	-	-	-	----

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ANALYSIS

The ground and surface water chemical quality in Azad Kashmir and parts of Pakistan [Khan et al 1996-2023]. Physical and chemical contamination, environmental contamination in food, water and vegetables [Imtiaz et al 2021, Daud et al 2022, Lesser et al, 2018, Mahmood et al, 2014], the vegetable chemical contamination and sea food contamination has been evaluated [Imtiaz et al 2021]. The water quality in Pakistan physically examined by [Alam et al 2016, Daud et al, Imtiaz et al 2021, Shahid et al 2018, Bahar et al 2013, Khalid et al 2017, Rafiq et al 2018, Orion et al 2009, P ark et al 2020]. The Pb 1.9-3.8 Islamabad, Nullah Lai and Bahalpur drinking water effect nervous system, red blood cells and reduce cognitive development and intellectual performance. Death in childrens has been recorded. Cd 0.2-2.7 in water, food and vegetables damage renal tubular function associated with high risk of lungs and breast cancer. The Ar 0.5-1.8 is > WHO and EPA recommended limits, associated with dermal , respiratory, nervous mutagenic and carcinogenic effects. The Ni 1.2-2.3 associated with dermto-toxicity, lower body weight and feto-toxicity among pregnant women. The Hg 0.1- 3.2 linked to cardiovascular reproductive and development toxicity, neurotoxicity, immune-toxicity and carcinogenicity have been observed. The environmental pollution is another risk for health. Some metals come from natural resources like rocks and soils. They contaminate vegetables and grains which grown from soil. A big source of contamination of groundwater are pesticides and fertilizers. The radionuclides dissolve in water. The waste from chemical

industries and hospitals, improper disposal of hazardous waste also contaminate natural resources. Air pollution contaminate vegetables, fruit, grains, and water.

From air pollution > 4 million deaths have been recorded per year, including 2 million deaths of children under 5 years [EPA 2004, ETO, NESHAP, OAR, EPASEPA 2024, Mahmood and Mallick, 2014], demonstrated the contaminated vegetables in Pakistan has a higher capability to accumulate the heavy metals from environment and soils. Heavy metals in different plants grown in nearby land fill sites $HRI > 1$. [Jahon et al, 2016, Kamal et al, 2016, Alam et al, 2020]. Risk index calculated HRI for Pb, Cd, Mn > 1, both for adult and children [WHO, EPA, Jahon and Kamal, 2016, Alam et al 2020]. Pb is very high. Pb 1. 2-3.8, exposure through plants and food may cause anemia, weakness, kidney and brain damage. Cd is a highly toxic carcinogenic that is harmful to most of the bodies systems [Hutton, 1987]. The pollutants in air are 0-500PSI, above 300 are highest level [Johanson et al 2016]. SO₄, SO₂, NO₂, CO, and O₃ in the environment are harmful for health [Ashraf et al 2021]. calculated hazard index in vegetables, groundwater, in soils, and found that the vegetables and groundwater are health risk because the vegetables are grown near leachates and chemical industrial waste water is supplied to vegetable growth. The carcinogenic elements are added in the body by environmental pollution, eating fruits, vegetables, fish. They are three fold from the requirement of body as nutrients. The excess of carcinogenic elements in body by different means create diseases leading to cancer and to death. 83% diseases and 33% deaths are due to water [Farooq et al, 2008]. 2.5 million deaths are diarrheal disease each year in Pakistan. Water borne diseases 50-80% with 40% of deaths due to poor drinking quality of water. Fasilabad need 65 million gallon water /day for drinking. 3 million gallon water come from soil where current water supply is 79 %. Remaining deficiency they meet from Nullah, streams and springs which are not safe for drinking and cause Infections Frooq et al, 2008, Olsen et al, 1954, Park et al, 2006, Rehman et al, 2019].

Table: 6. Water available, supply, water borne diseases, deaths, in Pakistan per year

Children deaths	Cholera *	Typhoid	shigellogis	Amoehisis	Food poisoning	diarrhea	Infections
Adults deaths	118442	p/y	p/y	p/y	p/y	p/y	p/y
Diseases due to water	180000 deaths occur/y with cancer	973	805	450	139	2908	2405
Approach to safe water %	25%	Nalluh Lai Not safe	Pb	Cr	Hg	Cd	EPA 2008, WHO, 2004Hina et al, 2020
Peoples in Hospitals	*		1.3 mg/l	4.6 mg/l	0.29 mg/l	0.38 mg/l	
Cancer Lung	1990	2012	2019	Colon Cancer	2010	2019	
WHO	2024	118442 individuals lose their lives to cancer	173937 new cancer cases are identified	DAWN ISLAMADAD 4.1 Million cases prevalent in Pakistan	1.7 million are mails	2.4 millions are femails	2.7 million cases are reported every year

WHO and EPA, 2024, DAWN Islamabad 2024, by Ikram A., Shahid P., Tahir K.M., Hafeez ud din, Fahrana B., Ahmed I., Masood Zafar I. A., Khattak, Samina N., Tayyaba R., Nighat M., Faraha N., Memon, Sumara A., Faiza B., Ibrar R., Ayaz M.M., Roshan K., Aisha S.2023.

Along males are lip, and oral cavity cancer patients are 46500. 45 000 patients larynx and lung cancer, 28000 cases on prostate cancer are reported and 19600 cases on colon and rectal cancer have been identified. Every year 180000 deaths

occurs. A result of cancer [88000 Males and 91500 Female]. Females are 40-50% / years [Dr Jan Said Minister Health, 2024].

Frequency of cancer in both genders including children, adolescents and adults

Aamer Ikram, Shahid Pervaz, Muhammad Thair Khadim, Muhammad Shoaib, Hafeez ud din, Fahrana Badar, Ahmed Ijaz, Masood Zafar, I. A. Khattak, Saima Naz, Tayyaba Rahat, Nighat Murad, Faraha Naz, Memon, Sumera Abid, Faiza Bashir, Ibrar Rafique, Muhammad Ayaz Mustafa, Roshan Kumar, Aisha Shafiq [2023].

Lip/oral cavity				
Salivary/glands				
Oropharynx				
Naso pharynx				
Hypopharynx				
Esophagus				

Table : 7. Cancer Frequency, the type of Cancer, Body Parts, Cause water, vegetables, fruits, environmental pollution, indoor and outdoor pollution, processed meats, foods, beverages, tobacco.

Stomach	3667	1834	16	29
Small intestine	418	280	21	16
Colon rectum	8024	4860	140	367
Liver	8398	3552	83	50
Gall bladder	1205	1215	2	2
Pancreas	1668	1042	2	15
Digestive organs	215	163	2	15
Nasal cavity	881	497	53	44
Larynx	3994	725	9	15
Bronchus and lung	7541	2397	17	39
Bone Marrow	2054	1175	1034	196
Blood				
Skin	3890	2834	111	85
Soft tissue	2647	1771	543	341
Breast	1383	56250	27	213
Vagina	829	6	3	3
Cervix	0	6043	7	17
Uterus				
Ovary	0	8823	185	318
Penis	54	0	0	0
Prostate	7322	0	5	2
Testis	2072	0	129	136
Kidney	2673	1450	603	51
Ureter	36	13	1	0
Urinary bladder	6149	1434	27	6
Eye	1178	832	734	40
Brain	6292	3471	1503	588
Nervous	488	315	187	61
Thyroid	1265	2944	37	125

Aamer, I. et al, 2023, 10.29271/jcpsp.2023.06.625. J. College and Physician and Surgeon Pakistan. EPA, WHO, Alam, I. Nasir, M. K.K., Shaid, M., Forman Ullah D., Lubna, S., Ihsanullah, I. 2020, Springer, Science, Springer Nature, 2020. Bull. Environ., Contamination and Technology. Doi/101007/s00128-020-0298-z.

DISSION AND CONCLUSION

The sample sites were selected on the basis of water contamination by different sources. In Azad Kashmir the sources of contamination are waste water from hospitals, waste water from homes, chemicals from agriculture, pesticide, wastes from city, animal wastes, environmental pollution, and infectious from radiological materials from hospitals. The water samples were analyzed from PCSIR Karachi, EPA Islamabad, University of Karachi, using Atomic Absorption, electron microscope and Spectrometer. Old literature and new research papers were also studied for comparison. More than 3000 samples were collected and chemical analysis were carried out in PCSIR, EPA, RCD Laboratories and University of Karachi. Water borne diseases were determined from chemical elements present in water and the blood samples. In some areas of Pakistan drinking water was highly contaminated. The environmental data was collected from ASCR, EPA, WHO and NLH, ANLH. ASCR Research on Indoor pollution, outdoor pollution, food contamination, vegetables, fruits, soil, leachates contamination and mining.

The Pb in spring water was highest near CMHR. The spring water near CMH Rawalakot has Pb 9.2 which is too dangerous for health [Table -3]. The Kanaparot Pb 1.2, Baibakh 3.6, Chotagala 4.2, Khaigala, 4.2, Trar 3.5, Banjosa 0.8 and Dhamni 1.5 IS higher than EPA and WHO limits 0.001- 0.005. Chemical and Leachate oriented vegetables also show Pb > WHO and EPA limits. The iron range is 0.5 -8.2, Cd is > WHO and EPA limits and range from 1.5-8. The Mn is highest in the area. Upper limit is 9.1 and lower limit is 0.9. Zn 0.1-8.1 and Ni 2.2 - 9.2 is highest in Nullah water.

The spring water in similar locations Pb, 1.8- 5.6, Cu, 1.2 - 3.2, Ni, 0.8-2.9, Zn, 1.6-4.2, Mn, 1.2- 3.6 in all locations. The all locations contain carcinogen in spring water > WHO and EPA.

Farooq et al 2008 determined coli and E-coli, in tube wells, spring water, nullah water in Rawalpindi -Islamabad, City area, Rawal Lake, Water Filtration Plants, in Bahawalpur, Fasilabad, Gujranwala, Gujrat, Kasur, Lahore, Multan, Rawalpindi, Nullah Lai, Westerage, Sheikhanpura, Sialkot, Wah Kent, Abbottabad, Banu, Noshera and put all waters in health risk. Chemical analysis also suggest all waters in high risk. The safe water in Pakistan is available only 25% peoples. 75% peoples are on high health risk.

Imtiaz et al 2021 declare toxic risk in the region. Imtiaz et al 2021 also calculated daily intake of carcinogenic elements. The calculation is based on each metal mean concentration in food, and consumption. The value of As, CO and Hg were high. The NYSDOH [New York State Department of Health] suggests EDI/ Df ratio is < or = Df related to minimum health risk. 1-5 Df related to minimum health risk. 5-10 moderate and 10-100 related to high health risk. It was estimated from EDI/Df that As metal in fruit and vegetables is 1-5 higher than Df is low health risk. In leafy vegetables it is 5-10 times higher moderate health risk [Imtiaz et al, 2021]. Frooq et al 2008,[DEHS, Department of Environmental Services 2010], indicated that Lakes and reservoirs are polluted with surface water [Health Canada 2006]. Microorganisms indicated in water > recommended limits [WHO, 2004]. In Karachi 10 million people 86% of the total population drink unsafe water. Only 28% get tested water available but that was also not safe. All drinking water contain Coliform > permissible limit [PCSIR, 2006]. WBCWWRAS 2005, EPA 2005] indicate that filtration plants in Islamabad and Rawalpindi are not cleaning water to satisfactory level and allows microbes to go untreated. No serious initiative has ever been taken to address these issues.

Table: 8. Microbial Found in waters of all Districts of Punjab, Sheikhpura, Lahore, Gujranwala, Multan Kasur, Bhawalpur, Rawalpindi-Islamabad.

Punjab	45%
Sheikhpura	73
Lahore	100
Gujranwala	64
Multan	94
Kasur	100
Bhawalpur	88
Rawalpindi	

Farooq et al 2008, Alam et al, 2016 Imtiaz et al, 2021 Lesser et al, 2018, Arfin et al, 215

Mg > WHO guidelines. In Peshawar drinking water is highly contaminated. As, CU, CO, Hg, Ni, Zn, Pb, NO₃ > WHO. Daily intake of K by adults < 0.1%. If K level decrease in blood, hypertension, kidney disease, heart problems, muscle weakness, bladder weakness, asthma, may be caused. K level decreasing in blood reduce renal functions and increase heart beat. Na decrease in body cause low blood pressure, increase depression. Increase in Na cause brain stroke, kidney problem, Nasuea, headache, hypertension, stomach problems, cardiovascular disease. Fe > WHO guidelines cause weakening of cardiovascular tissue, Central nervous system, kidney, liver, blood problems, vomiting, diarrhea. In Rawalpindi Islamabad 4000 cases of hepatitis were registered in 2021 due to unsafe water. 50% cases were gastro, 59 % diarrhea, 38% dysentery. In Sindh hepatitis cases were 38 %, Punjab 19%, Karachi 20%. Water demand in Rawalpindi - Islamabad is 173 million gallons/day. This demand is fulfilled from Nullah Lai and Warsak dam. The quality of water is not satisfactory.

[Fabian Fernandez, Luquefio, Fernando Loopez-Valdez, Procoro Gamero-Melo, SilviaLuna, SubrZ, Elsa Nadia, Aguilera-Gonzalez, Arturo, L, Martinez, Maria del Socorro, Garcia, Guillermo, GildardoHernandez-Martinez, Raul Herrera -Mendoza, Manuel Antonlo Alvarez, Garaz and txchel, RubiPeraz, Velazquez. [2013]. Heavy metal pollution in drinking water. Aglobal risk for human health: A review, National Institute of Sciences Geography, and informatics Oxaca , C.P, 68050 MeXico.

The environmental pollution contribute more than the other sources. P2.5 particles pollute not only the air but also the vegetables, sea food the soil, and the interior of houses the living area [NESHAP, EPA, ETO, NPDWR, 2004-2024]. The trace elements in atmospheric particles originate from natural and atmospheric sources, wind action on earth crust produce mineral dust during major storm events resulting in hazardous particles in atmospheric loading. The size range is $d > 1 \mu\text{m}$. These particles undergo accumulation mode $0.1 < d < 1 \mu\text{m}$. The industrial environmental pollution, mineral dust, coal, fly ash, oil, mostly in the fine $d < 2.5 \mu\text{m}$ and $d < 0.1 \mu\text{m}$. This includes oxides, carbonates, sulphates, in a matrix of clays oxides and alkali. The elements include Fe, CU, Mn, As, Pb Traffic related Mn, Fe, CU, As and Pb vary location to location. The people inhale $2.5 \mu\text{m}$, [PM 2.5] Ultra fine < 0.1 [PM 0.1]. These particles including carcinogenic elements effect health linked to cardiovascular diseases, lungs cancer, brain function, damage [Park et al, 2006]. ACSR, EPA, WHO, 2004, analyzed toxicity, inhalation and ingestion [ACS, 2015, ACS, 2022]. The function of a compound that is released from its matrix to the surroundings such as gastrointestinal tract enter the blood stream or up take by biota at sea surface micro layer [SML], 2.5% of CU, and As released in saliva gastric juice and lung fluid compared to 26% saliva juice. The highest release of Pb 77% and 61% was in gastric juice. WBCWRAS, EPA, 2005, reported that filtration plants in Islamabad -Rawalpindi are not cleaning water to satisfactory level and allow microbes to go undetected . No serious initiative has ever been taken to address this issue. Even in Federal Capital and its twin city. All reports revealed water in twin city unhygienic due to bacteriological contamination. All school, colleges were positive for total coliform and fecal coliform. [Frooq et al, 2008, Hashmi et al, 2009, Khan et al, 2023]. No improvement was found with time in water quality. With time widespread bacteriological contamination of water in distribution network and at filtration plant in Islamabad-Rawalpindi [Mashiattullah et al 2010]. Punjab has lower quality of water due to high contamination revealed by several studies. Lahore has unclean water, 37.2% water unfit due to coliform above permissible limits [Anwar et al 2010].

CONCLUSION:

The research suggests the heavy metals carcinogenic elements in water, vegetables, foods, and environmental pollution is a big risk for health.

The concentration of As, Cd, Pb, Cu, Zn, Cr, Fe, Hg exceed recommended limits by WHO and EPA.

In vegetables the chemical contamination is very high and risk for human health. Environmental ingestion increase risk of cancer. All vegetables grown using industrial water waste showed high risk for human health, those vegetables grown with safe water have low risk.

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