

STUDY OF HEAVY METALS (Cd, Co, Cr, Cu, Mn, Ni, Zn, Pb and As) IN DRINKING WATER OF NOSHAKI DISTRICT IN REGION OF BALOCHISTAN

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ABSTRACT: The current experimental work was carried out to check the heavy metals like cadmium, chromium, nickel, lead, copper, zinc, cobalt, manganese and arsenic concentration in potable water samples in the Noshki areas. This experimental work examines the possible health risks effects by using heavy metals to the localities of the Noshki. This study was aimed to obtain the specific objectives to assess the presence of Toxic heavy metal pollution to the environment.

Keywords: Heavy Metals, Health risks & Portable Water

1. INTRODUCTION

The general geological map of Nushaki is given below in Figure-1.

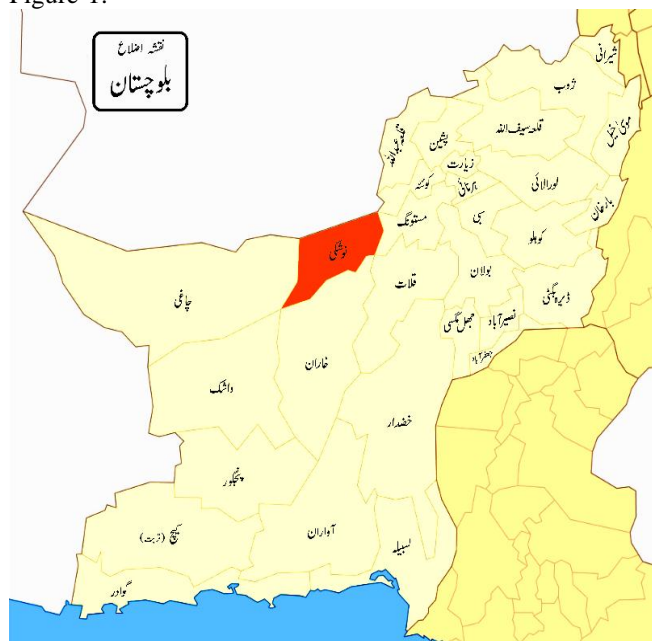


Fig.1: Geological map of Nushaki.

Balochistan province is the largest province of Pakistan in terms of the area, 40% of the total, bordering with Iran, Afghanistan, Federal Administrated Tribal Areas (FATA) and the Arabian Sea, but the thinly populated. Tribal culture and nomads dominate living environments. Quetta is the capital of Balochistan which lies near the border of Afghanistan.

This province is one of the largest arid zones of the country. Short of the irrigation system in this province, the population mostly depends on underground water resources for agriculture, industry, drinking and other domestic uses. Table 1 below show

s the consumption for different purposes.

Table.1: Consumption of water

Purpose	(Percentage) %
Agriculture	69
Industry	23
Domestic use	8

In Pakistan,, about, forty-five percent of rural and eighty percent of urban population has accessibility to safe drinking water. Rapidly growing pollution is the basic reason for spreading water-based diseases. Forty percent of hospital wards in Pakistan are found to have been occupied

with patients who are infected by water pollution -related diseases.

The majority of villagers obtained water for daily usage from hand pumps or power driven pumps and found that just seven percent of villagers used the water which is obtained from wells or from rivers and canals. More than sixty percent of living beings in cities and seventy percent of peoples in villages get water for drinking purposes from hand or power driven pumps. Mostly in cities, subsurface water quality and quantity worsens the situation to avail the best quality water for human consumption. In excess of distraction results that the subsurface water level is declining. Untreated, industrial effluents freely drained in fields nearby have a serious impact on underground water resources. Toxic elements from effluents freely drained in the fields penetrating in underground sources causing serious health hazards for the animate and inanimate ecosystem as well as agriculture. The availability of pollution-free water is thus the most serious problem for the citizens of Pakistan..

The results are carried out from different surveys and investigations that water pollution greatly increased in Pakistan mostly in big cities that have industrial zones. So, it is very necessary to take serious efforts to counter these water pollution challenges and to resolve the scarcity of water in Pakistan.

Water which has bad quality has main socio-economic effects for Pakistan and a greater level of pollution in rivers and subsurface water has led various effects on the environment like falling of biodiversity, raise correlated water diseases and reduction in agriculture production. Furthermore, poor management in irrigation badly affects the economy mostly in food and health. Only eight percent of total wastewater is being treated in treatment plants that flow in open drains and have no path for reuse of the treated water for agricultural and municipal use. The water bodies have no idea to handle the rapid increase in pollution. There is a very little separate system of municipal waste from industry effluents in Pakistan which flows openly in open drains.

The safe and best portable water quality is the main key to human's health. The water provides several rudiments, but when it is contaminated it becomes the cause of unwanted substance, the danger for health and may cause diseases such as cancer, effected reproductive results, and teeth diseases. The population of all ages is most vulnerable to the toxic effects of heavy metals, particularly children from infants to juvenile stages, as their body system is highly sensitive [1]. During infant to the juvenile stage of the children, heavy metals affect the memory, learning

difficulties, affects the nervous system and behavior issue like hyper and aggressive issues [2]. The heavy metals at maturity and beyond affect brain damages. Children get a high dosage of metals from foods than youngsters that is why they utilize a large amount of food than youngsters. The presence of heavy metal arsenic in subsurface water in various rural areas is very detrimental to human health [3]. The heavy metal like arsenic and its compounds are the by-products of the metallurgy industry, ceramic, fertilizer, petroleum refining, and chemical industries. In various parts of the world, arsenic founds in the soil and to be found in subsurface water [4]. These heavy metals exclusively damage the body's development mechanism. The lead is soft and having gray color metal and EPA classify that the lead is very equally dangerous for human health. The lead also found in the air by the release of exhaust gases from vehicles, as, the tetraethyl-lead is used in fuels as an anti-knocking agent. Old water pipes and fixtures are also sources of lead pollution [5]. The aluminum not belongs to heavy metals and contains approximately eight percent of the earth's surface and 3rd richest element of the earth. It affects the human brains when it is found in human beings' bodies that may cause the collapse of the nervous system. The recommended quantity of heavy metal in 1 liter of potable water is 0.006 milligrams per liter, 0.015 milligrams per liter for lead, 0.010 milligrams per liter and 0.05 to 0.2 milligrams per liter. So metals like Lead, Arsenic, Mercury, Copper, Zinc, and Cadmium. In the human body, different metals commonly Copper, Zinc and Chromium are needed in a smaller amount [6].

Water (H₂O) is a very important element for living beings. The potable water is a very necessary thing for human health, so it is suitable as well as excitedly nice to go out, while on the spot of delivery to the users too. It is very necessary to use only safe drinking water which is the best way to ensure good health. Many of the rural areas of the world affected by turbid water with metals that cause deaths and other dangerous diseases [8].

Water which is obtained from tube wells is very dangerous for human health and the public has no other option for drinking water and people continue to drinking existing water which can cause diseases like skin, cancer, and other diseases. The presence of various metals like mercury and lead can cause the immune system.

Rural poor communities in the developing world use their own initiatives to approach portable water from either subsurface water or surface water sources. The water is fetched by the use of buckets from surface water and water can be obtained from circular dug holes in case of subsurface water. For obtaining subsurface water, a hole on the ground can be drilled [10]. The tube wells penetrated in aquifers and water not be confined by an overlying impermeable layer. When the soil is found full of saturation that level is known as the water table and nearly water can be pumped and they

are very sensitive due to seasonal variations during the dry season the level goes considerably down.

The environmental professionals are now particularly focused on heavy metals that contaminate the surface and subsurface water. Weathering of rock and anthropogenic activity are measured chief natural or artificial sources of heavy metal accumulation in the resource of water [11-13]. The heavy metal in a greater amount may important or not important for the ecosystem [14]. Ejection of harmful industrial waste in the water systems is very dangerous for human health and aquatic life [15]. The raw material of the industry of sugar creates ethanol productions by fermentation techniques in distilled industries. To obtaining one tone of ethanol thirteen to fifteen tones of washes are required by the industries [16]. World over, industrially, thirteen million ethanol is obtained for that 156 to 195 million is drained for washing [17]. The heavy metals like zinc, cobalt, and copper are very necessary for organisms and the growth of the body. Cadmium, lead, manganese in greater amounts are very dangerous for human and aquatic life [18]. Fix the amount of chromium is needed for functions of the body; while a greater quantity of chromium affects the kidneys, liver, and cancer [19-21]. The cobalt is the ingredient of vitamin B12 and it is needed regularly for the functions of the body [21]. Furthermore, taking water and food having cobalt in greater quantity affects the arteries [22]. The manganese is a very significant metal for human organisms and enzymes while its percentage may cause the disorder of the nervous system especially brain diseases, and portable water has a greater amount of manganese disturb the functions of children's body [23-25]. Meanwhile, the nickel sulfate and nickel chloride affect the respiratory system, excretion system, and allergic skin diseases. [19, 26-28]. Lead is too dangerous metal, for human health and may cause the diseases of headache, vomit, damages of the brain, blood pressure and cancer [29 - 31]. Zinc is not more dangerous metal for human health like another type of metals; it may cause the fatigue of a body and its fewer amounts in the body may affect the loss of hairs, weakness of muscles and cause diarrhea [21, 32]. The cadmium is a very dangerous metal like lead and affects red blood cells, testicular tissues, and kidney damages. The excess of cadmium causes skeletal damages and cancer diseases in human beings [33-37]. The statistic analysis being conducted out to manage resources of water and solve contaminated issues [38]. Highly s of heavy metals and chemical characteristics in subsurface water and surface water being highlighted previously throughout the world adopting health risks assessments and static analysis [13, 39-41].

This experimental study finds out the effects of washing stored in evaporations pond on the subsurface water which are used by human beings. Standards of water quality of evaporations pond and subsurface water can be checked by the standards of the World Health Organization to highlight the

possible contaminations of subsurface water and affect on human beings.

2. EXPERIMENTAL

This experimental work is carried out in Noshki district. To obtaining the specimens plastic bottles of 1.5 liters were used. These specimens were recurrently designed by average n is equal to three. The standard methods were used to find out the characteristics of elements like cadmium, cobalt, chromium, copper, manganese, zinc and lead [42]. The specimens of cadmium, cobalt, chromium, copper, manganese, zinc and lead were washed and diluted with a ratio of 1 and 100 with distilled water for drained and subsurface water 250 milliliters 1.25-milliliters of nitroxyl samples were added and heated on three water baths about fifteen milliliters and filtered. The total volume was used to twenty-five milliliters with doubled distilled water. Most of the chemicals used were of analytic grades with the appropriate amount of the salt of existing metal and were dissolved in hundred milliliters to make one thousand parts per million stocks of the solutions and other dilutions were conducted out by deionized water. Cadmium, cobalt, chromium, copper, manganese, arsenic, zinc and lead were analyzed by Air Acetylene Flame Atomic Absorption Spectrophotometer with standards and with the help of win lab software. Furthermore, for ten percent of specimens were also analyzed in the labs by using Perkin Elmer analyst. Arsenic hydrides were used by adding ten percent hydrochloric acid and 0.2 percent sodium hydrides. The five specimens of solutions 1, 2, 3, 4 and parts per million were used for every metal for calibration of equipment and solution 2 and 3 parts per million were checked out for the performance of the instrument and if the errors were noted above than five percent then recalibrate the equipment according to the standards.

3. RESULTS AND DISCUSSION

Environment and health of the living beings affected by heavy metals and dependent on the movement of every metal throughout the environment and its surroundings. The country Pakistan has great concerns and reflections to the living beings for contamination factors with heavy metals which are shown in table 2 and fig.1.

The cadmium is metal which is very harmful to human health and organisms. Cadmium widely presents commonly

beneath the earth's surface and oceans [43]. The cadmium is present in abundance throughout the world with an average of 0.1 to 0.2 milligram per kg and in oceans its ranges from five to one hundred and ten milligrams per liter [43]. The cadmium and its compounds are very harmful to human health according to the statement of the International Agency for Research on cancer and also it causes lung and kidney cancer [43]. Also, cadmium damages the skeleton, kidney and pulmonary damages [44-45]. According to the World Health Organization, the limited amount of cadmium in portable water should be 0.003 milligrams per liter [30]. High concentrations of cadmium in Pakistan in portable water is due to effluent discharge from marble, steel, and aluminum industrial zones and also from minings and metals plating's [21]. The highly concentrated water samples with cadmium obtained from different sites of Pakistan ranges from 0.001 to 0.21 milligram per liter [33]. The greater amount of 0.21 milligram per liter was calculated in the specimens who are collected from tube well water located from the industrial zone of Hayatabad, KPK with an averagely of 0.02 milligram per liter [44]. Furthermore, cadmium concentrations in surface water show the greater variations overall the country and range in between 0.2 milligrams per liter [45, 46]. However, water samples of Kalar kahar Lake Chakwal, cadmium remain unpredictable in march and april due to seasonal variation in other months of the year like 0.001 to 0.05 milligram per liter [47]. The concentrations of cadmium in specimens of surface water obtained from KPK which ranges from 0.002 to 0.09 milligram per liter. Further, the samples of water shows the variations in cadmium in river Malir Karachi is in between 0.002 and 0.07 milligram per liter [20].

Most of the experiments show that the cadmium is present in a greater amount in wastewater specimens which are obtained from different parts of Pakistan. Highest concentrations were found in the korangi area of Karachi ranges from 5.35 milligram per liter which are greater than the ranges which are given in Pakistan Standards [48, 49]. Furthermore, in different parts of Lahore, concentrations of cadmium in wastewater were too greater than the safe limits as per the standards which having ranges between 0.18 to 0.37 milligram per liter [50]. Another experiment was carried out in Swabi industrial estate which has the range 0.19–0.62 milligram per liter [51].

Table 2: Level of heavy metals (ppm) in portable water in Nasirabad District

Serial No	Sample collection point	Cadmium	Cobalt	Copper	Manganese	Nickel	Lead	Zinc	Arsenic
1	Sample 1	0.01	0.03	0.3	0.1	0.21	2.25	0.21	1.08
2	Sample 2	0.12	0.04	0.4	2.2	0.24	6.35	0.39	2.5
3	Sample 3	0.13	0.035	0.5	2.3	0.23	6.34	0.4	2.6
4	Sample 4	0.11	0.031	0.3	2.4	0.22	6.4	0.69	2.3
5	Sample 5	0.2	0.02	0.3	2.45	2.69	7.13	2.3	1.9

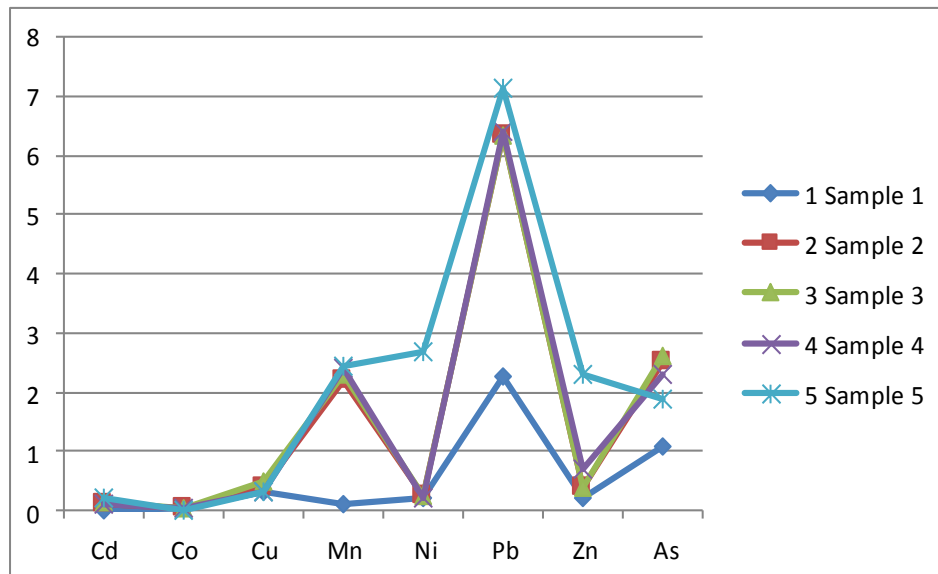


Fig. 1: Level of heavy metals in portable water of Noshki District

Table 3: Permissible limit

Heavy metal	Permissible limit				
	WHO	USEPA	ISI	CPCB	ICMR
Iron (mg/l)	0.1	—	0.3	1.0	1.0
Copper (mg/l)	1.0	1.3	0.05	1.5	1.5
Mercury (mg/l)	0.001	0.002	0.001	No relaxation	0.001
Cadmium (mg/l)	0.005	0.005	0.01	No relaxation	0.01
Arsenic (mg/l)	0.05	0.05	0.05	No relaxation	0.05
Lead (mg/l)	0.05	—	0.10	No relaxation	0.05
Zinc (mg/l)	5.0	—	5.0	15.0	0.10
Chromium (mg/l)	0.1	—	0.05	No relaxation	—

WHO: World Health Organization, USEPA: United States Environmental Protection Agency, ISI: Indian Standard Institution, ICMR: Indian Council of Medical Research, CPCB: Central Pollution Control Board.

Anthropogenic and natural resources contribute to the level of cadmium present in soil and deposits like mines, sewerage sludge and municipal wastes [43]. Overall in the world stated that the sediment concentration of cadmium ranges from 0.03 to one milligram per kg in marines sediment and greater in river and lake sediments which range above 5 milligrams per kg.

In the different areas of Pakistan, it is noted that the soil has the variation in cadmium ranging from 0.02 to 184 milligram per kg as of common soil to the contamination soil by mines and different phenomena [52, 53]. Furthermore, an experiment was made in Sargodha, the cadmium in the soil was obtained 6.74 milligrams per kg [54].

The cadmium concentration was calculated on Expressway of Islamabad and city ranges from 5.8 to 6.1 and 4.5–6.8 milligrams per kg which are greater than the cities of Turkey and Jordan [55-57].

The cobalt (Co) is the chemical element that is found in the earth's crust with nickel. Cobalt is the one element that has present with the combination of nickel. The cobalt like blue pigments was also used previously in jewelry and painting. Most of the countries called the name Kobold; Germans called Goblin ores because they have not able to identify the metals. After that previously the latest metal was found out and called Kobold in 1735.

Now day cobalt is formed by different metal ores like that cobaltite while the major resources of elements are the byproducts of Cu and Ni. The cobalt mines are found in greater amounts in the Democratic Republic of Congo, Central African Republic, and Zambia.

The Co is used primarily as a metal by making magnetic and high strength alloys. The Co - II Aluminate which has a dark blue color, used in making glasses, ceramics, ink, paint, and varnish. The Co is an energetic hub of coenzymes known as Co-balamins like B₁₂ vitamin.

The chromium is a very significant compound like industries of steel and metallurgy. It's oxidations three and six in the chemicals which are used in metals finishing, pigment and wood preservations [61]. The major cause of chromium is the leather tanning while wastes are discharged openly in the stream wastes. The chromium compound causes lung cancer, nasal cancer. In different areas of Pakistan chromium is present in subsurface water range variations from 0.001- 9.8 milligram per liter is the higher value than the residential areas of Kasur Pakistan [37]. Furthermore in Nowshehra KPK contaminations were calculated in Bara River ranges from 0.16 to 0.29 milligram per liter [45]. These experiments show that the industry wastes water impact on the quality of water. The extent of dangerous effects with chromium concentration in

subsurface and surface water do not be analyzed except chromium not defines well. Most of the researches reported that the chromium contents in soils ranges 100 to 150 milligrams per kg should be acceptable and the world's soil average contents of chromium recognized 60 milligrams per kg [61]. The great amount of chromium in leaves and edibles of vegetable were estimated [53]. Another experiment estimated that the amount of chromium in the ranges of 3.93 milligrams per kg /kg with contaminated water and from portable water it gives the range 0.004 milligrams per kg were calculated [33].

The copper is a very significant element and present in foods and livers of animals [64-65]. The copper acts as a reductant in different types of enzymes and shifted in the organisms by the proteins [66] and its recommended dietarian allowances for adults are 0.9 milligrams per day. According to American standards, the copper intake is about 1.0 to 1.6 milligram per day for youngsters and bearable above level of intake for youngsters is 10 milligram per day [65]. Most of the authors report that in Pakistan the surface and subsurface water which contaminated with copper does not create any issue. According to Pakistan standards the limit of copper in the range of 2 milligrams per liter (Table 1, Figures 3 and 4) [30]. Furthermore, there is just one experiment show the measurable dissolved concentrations of Copper in subsurface water ranges from less than 0.0001 to 2.8 milligram per liter [18]. The water sample from Azad Kashmir shows that the higher concentrations of 2.8 milligrams per liter but in other experiments, the copper is found in the limits of the standard which is safe for drinking [18].

The manganese is used in the treatment of rust and corrosive depends upon the state of oxidations ions of manganese have different colors and widely used in industries as pigment. The manganese dioxides are used as cathodes like carbon-zinc and alkali batteries. Manganese ion in biology has many factors with different varieties of enzymes with most characteristics [67].

The nickel is mostly divided naturally and it is present in plants, animals, and soils. The concentrations of nickel in soils are about in the range of four to eighty parts per million [43, 68]. The big quantity of nickel is out in the environment because of natural and anthropogenic behaviors with fossils fuels consumptions, industry productions and disposals of Ni compound and alloy and wastes materials [43]. Human exposures to nickel outcomes can be obtained by contamination of food ingestions, drinking water, inhalation, and absorptions [43,68]. Furthermore, according to the international agency for research on cancer evaluations, nickel elements are very dangerous to human health, which causes cancer of the lungs and nasals cavities [43]. Maximum concentrations of nickel by the standards of world health organization in portable water is 0.07 milligram per liter, whereas Pakistan standards guidelines have the limit of 0.02 milligram per liter [29, 30]. Concentrations of nickel for surface and subsurface water in Pakistan are respectively 0.001 to 3.66 milligram per liter and 0.001 to 1.52 milligram per liter [20] and it was noted that the subsurface water is more contaminated with nickel as per the requirement of Pakistan standards. Furthermore, seventy-five percent of surface water specimens from the larger cities of Pakistan have greater values than the values of standards [20]. An

experiment was carried out in Lahore on the wastewater specimens to find out the impacts of wastewater on vegetables. Concentrations of nickel were achieved higher than the previous studies which have ranged in the limit of 0.91 to 5.94 milligram per liter which are above the Pakistan standards [49-50].

The presence of lead will affect the children and youngsters with many health issues like metabolic issues, renal failures and memories [69]. According to the international agency for research on cancer evaluations lead elements are very dangerous for human health while organic lead not dangerous for human health [70]. The lead is obtained from beneath the earth layers and lead affects the crop, soil, water, foods, fresh air when it enters the atmosphere [70]. Subsurface water specimens in Pakistan have greater values 0.01 to 4.7 milligrams per liter instead of 0.01 milligram per liter than the standard values. The samples which are collected from AJK the concentrations of lead were obtained in the range of 1.8 and 4.7 milligrams per liter [18]. The lead range was obtained in the Hattar industry zone is 0.01 milligram in the ratio of 0.26 milligram per liter [44]. Furthermore in Sialkot hundred percent of specimens are near about the level of 0.01 milligram per liter of lead ratio in drinking water [40]. Every study explained that the high percentage of lead founds in the country which is greater than the standard limits in surface and subsurface water. The proportion of lead was found mostly high concentrations have been estimated but the higher value was obtained in Bara River in Akbar Pura district Nowshehra KPK [45]. More than fifty percent of wastewater samples analyzed and found the level of lead near about 0.50 milligram per liter [49]. Hence the study tells that the higher percentage of lead found in the watercourses which are very dangerous for plants, soil, and the public.

The zinc is a very important nutrient which catalyzes enzyme activities, contributes protein structures, and regulates gene expressions [65]. However the deficiencies of zinc being predicted for years while it is very damaging [71]. Very sensitive effects are taking place when the zinc intakes are found greater than the standards and may cause headaches and immune systems [62]. The percent of zinc in younger's are eight to eleven milligrams per day as per the standards however above the level of intake of zinc at a young age is reached at a level of 40 milligrams per day [65, 62].

The arsenic is a very dangerous compound and has such significances in human health [43]. The greater amount of arsenic causes and develops diseases like liver cancer, lungs issue, gall bladders and kidney issues [73-72]. Arsenic was founded widely in 1990 in the subsurface water in different countries of the world like America, China, Taiwan, Hungary, Vietnam and the plains of Ganges [74]. WHO provides the guidelines and values of arsenic in potable water ten-micron grams per liter; meanwhile, different regulation bodies have suggested highlighting the campaign that arsenic is very harmful in portable water [30]. Furthermore, many areas of Pakistan are facing arsenic issues in portable water mostly in Punjab and Sindh [75-77]. The various resources of water in Punjab and Sindh have the contaminated percent 3 and 16 respectively and the contaminated level above 50 micrograms per liter [78-79]. The united nations children's and Pakistan research council for research and water council have signed the

assessment of portable water quality and the presence of arsenic in 1999 [19]. Subsequently, the occurrence of arsenic contamination in subsurface water found ten to two hundred micrograms per liters being reported in different regions of Pakistan mostly in Punjab [19, 36]. A national survey was conducted out to eliminate the arsenic in 2001 in thirty-five districts of the country [80]. In these surveys, 8712 specimens were tested and found 9% of these samples had a concentration greater than ten micrograms per liter and greater than the value of the standard [30] and less than one percent of samples have the value above than 50 micrograms per liter. Furthermore, the testing of 848/8712 specimens founds the As concentration above 10 micrograms per liter mostly in thirty percent specimens and seven percent greater than 50 micrograms per liter.

Some heavy metals have harmful characteristics and some heavy metals are too important for humans being healthy. Furthermore, heavy metals have some harmful considerations in terms of human health.

Many of the regions in Pakistan have serious issues about heavy metal contamination which affects human health. The literature of reviews tells that the greater percentages of heavy metals in Sindh, (village Boobak near Manchar Lake) were estimated near about thirty to forty percent which caused the allergic problems on the body [81]. The researcher calculated the total daily arsenic intakes of 343.5 micrograms per day for younger's while arsenic intakes from subsurface water were calculated in the limit of 241 to 390 micrograms per day [81]. Another experiment was carried out and result show that the sixty-one to seventy-three percent toxicity were found in the village on the lake of Manchar Lake [82]. Further, the researchers analyzed that there is a big relation between portable water and blood samples of the existing population. However the exposed peoples have medical characteristics like respiration issues, muscle and weakness issues Arsenic intakes by the lakes and subsurface water were calculated in the ranges of 33.6 to 390 for males in micrograms per day [82]. A further study carried out in tehsil Gambat Sindh by Baig et al. and says that there is a link between portable water and arsenic concentrations [83]. Comparatively in these studies, there is a great interlink between the portable water and arsenic which affects the lungs of the younger's [84].

A research was conducted out by Rahbar et al. and concluded that the eighty percent of children's in Karachi had found excess of lead concentration in blood i.e. greater than ten micrograms per liter per day with all average of 15.6 micrograms per liter per day because of higher level of Pb in the air which comes from polluted environment through vehicles [86]. Further in Karachi, the high Pb was found as compared to Islamabad. Consequently, when Pb is found in the blood it causes the physiological, neurological issues in human beings [86-87]. The environmental cadmium was also found in the school children's in Lahore areas [88].

4. CONCLUSION

Table 3 indicates the presence of pollutants far beyond the permissible limits.

Contaminated water is the main issue of the peoples of Balochistan. Localities of these areas tell that the bad drainage and sanitation systems affect the peoples of that area. Anybody and all the residents of Pakistan have the

right to participate in the campaigns made to overcome polluted contamination of water and responsible to make environment-friendly. In other words, the concentrations of all the compounds in water specimens extensively varied between location and the level of metal without zinc and nickel. The conclusion reveals that the artificial storage of water like dams, lakes and ponds affects the quality of water in the Nasirabad district.

5. RECOMMENDATIONS

- The portable water and environmental water should be monitored in cities and villages of the country.
- The industrial wastewater disposals must be hardly checked and adapt wastewater measures.
- Treatment plants must be installed in major cities of the country.
- The government should allow the local bodies to monitor and check the purification process of portable water.

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