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Deteriorating Health Conditions by Effects of Water Quality in Pakistan

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ABSTRACT

Aim of the Study: Drinking water quality is deteriorating due to major urbanization patterns and the rapid explosion of the population taking place in Pakistan. This article addressed the various problems of quality water associated with provinces and cities. The article seek some logical grounds of quantity trigger the issue of quality water production in Pakistan it is estimated Only 20% of Pakistan's population can access to fresh water for drinking. while the other 80% are prone to use unhealthy contaminated water due to scarcity of water (Daud, 2017).

Methodology: Current research study analysed the reports of water quality of four major cities of Pakistan i.e., Islamabad, Lahore, Karachi and Faisalabad.

Findings: The most water-stressed areas are one of those where negligence prevails among the people to wastewater. This situation hurts millions of people who depend largely on the agricultural sector for their basic needs and food security. It has an adverse effect on for energy production sector which uses hydrological ways to produce supplies for domestic and industrial use typically the water quality is determined by physical and chemical changes in the water due to many factors, mainly primary determinants are sedimentation, runoff, pH, weathered bedrock, temperature, pesticides, and detergents.

Conclusion and Policy Implications: Globally, the most persistent problem of water quality is eutrophication entitled to a high amount of lead and phosphorous content in water making it impaired to use. If available, water quality is countered with scarcity, shortage of clean pathways, drainage effluent mixing, cross-contamination by industrial and domestic usage, and inadequate technical capacity of service providers. The study showed that poor sanitation, monitoring, and treatment systems lead to a decline in drinking water quality. The presence of hazardous materials and bacteria in drinking water is detrimental to human health. Waterborne diseases have been reported in many instances. Dysentery, cholera, typhoid, and hepatitis are often reported watery infections in rural Pakistani cities.

Keywords: Water Quality, Water-borne Diseases, Hazard Assessment, Quantification of Water Quality.

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Introduction

Pollution typically deals with the number of natural substances in water in the form of microbes, nutrients, heavy metals, organic chemicals, and increased amount of raised temperature which tend to bring heat increment in the threshold which on the other end receiver is directly consuming. (Drinking water quality in Pakistan's current problems and challenges, 2021)When the population is exposed to such stagnant quality, waterborne diseases spread easily. The condition of water quality is still not satisfactory either in a metropolitan city or a countryside population even the worse conditions prevail in most areas of Pakistan. (Water for life, 2015) Access to safe water is recognized as a dire concern for the people of Pakistan. Water Pakistan is the world's most water-stressed country and is likely to become the most "water-scarce" in the coming years, therefore availability per person is drastically falling there. (Javed, 2018) The most water-stressed areas are one of those where negligence prevails among the people to wastewater. This situation hurts millions of people who depend largely on the agricultural sector for their basic needs and food security. It has an adverse effect on for energy production sector which uses hydrological ways to produce supplies for domestic and industrial use. (UNDP, 2017) The availability of fresh water per annum is 43.66 trillion m^3 to a population of 7 billion of the whole world which is calculated by the Falkenmark indicator, can be considered abundant but it is not uniformly distributed. The availability of 1700 m^3/capita is considered a water-stressed area whereas 1000m^3/capita is considered scarce water conditions in the country. Falken indices can be used to know the scarce or stressed water areas but it doesn't indicate how much water is available when there is a need for say crops or towns and cities when it is most needed. [(5)] (WWD, 2022) Humans must have access to clean water in order to survive, and providing enough clean water is crucial for maintaining human health and wellness. Quantity problem leads to issues such as high cost of health problems, low enrolment, poorly absorbed nutrients, and low work productivity which ultimately leads to poverty (WWD, 2022). Water-related infections cause up to 443 million school days to be missed worldwide each year. (WWD, 2022).

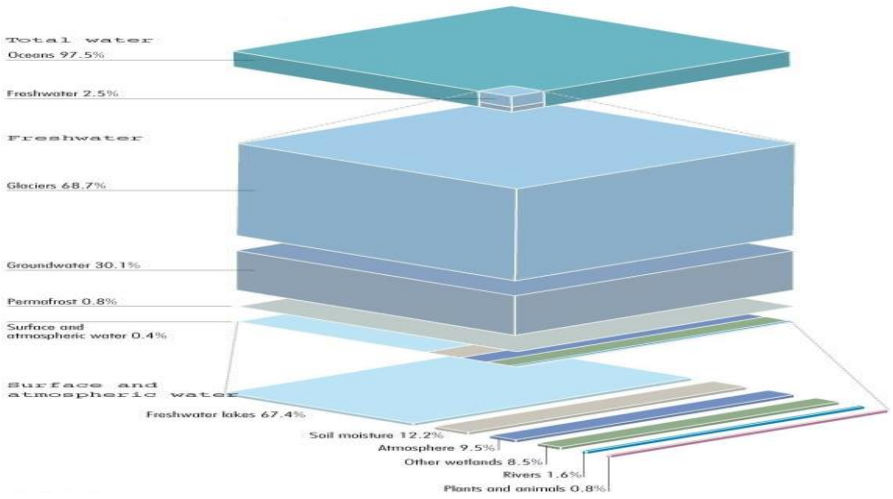
Water sources or pollutant sources can be used to categorise different types of water pollution. As a result, there exist several forms of water contamination. Water resource policies at all levels must be continuously assessed and updated due to the serious global problem of water contamination (both international and individual aquifers and wells). The leading global cause of illness and death is water contamination. Water sources or pollutant sources can be used to categorise different types of water pollution. As a result, there exist several forms of water contamination. Water resource policies at all levels must be continuously assessed and updated due to the serious global problem of water contamination both international and individual aquifers and wells. The leading global cause of illness and death is water contamination.

In Pakistan, just 79.2 percent of te poorest citizens have access to clean water, compared to 98 percent of the affluent. 53,000 Every year, children under the age of five die as a result of diarrhoeal infections. (Wateraid, 2022). Safe, clean drinking water supply, surface debris, Lack of water and inconsistent water delivery, improper discharge of water supply, the mixing of neighbouring sewage water and other contaminants, disposal of untreated sewage water and industrial effluents, negligence of service providers, and insufficient efficiency of technical workers are a few of the most significant obstacles to the provision of water with high quality that have been noted. For analysing water quality issues pertaining to industries, irrigation, and home usage, physiochemical and microbiological characteristics are crucial determinants. pH, Total Dissolved Solids (TDS), turbidity, hardness, nitrate, Electric Conductivity (EC), chloride, phosphate, and other characteristics are frequently used to display drinking water quality. (Ahmed, 2020; Ahmed, 2020). drinking water quality decline as a result of contaminants getting into fresh water. Water supplies and water bodies through both natural and human-made processes. While anthropogenic pollution is primarily caused by the use of pesticides and herbicides in agriculture, toxic leaching, septic tanks, garbage disposal, coal mining, and oil refining, among other things, natural or geological pollution of water depends on the presence and concentration of various chemicals primarily from the composition of geological formations in a particular area (Garn, 2016)

Objectives of the Study

1. The study focusses on addressing the problems associated with water quality issues
2. Parameters of quality assessment associated with quality standards are interlinked with associated diseases.
3. Quantification of water analysis in different cities in Pakistan.
4. Effects of contaminated water on human health and security management.
   The study raises the following questions:
   How water quality issues are interdependent with anthropogenic factors?
   What type of water quality parameters are associated to calculate risk of water-borne disease.
   What factors are contributing for low quality of water?
   How water borne problems are affecting on health and what plans can be devised for solution?

Figure 1: *Global availability of Fresh Water*

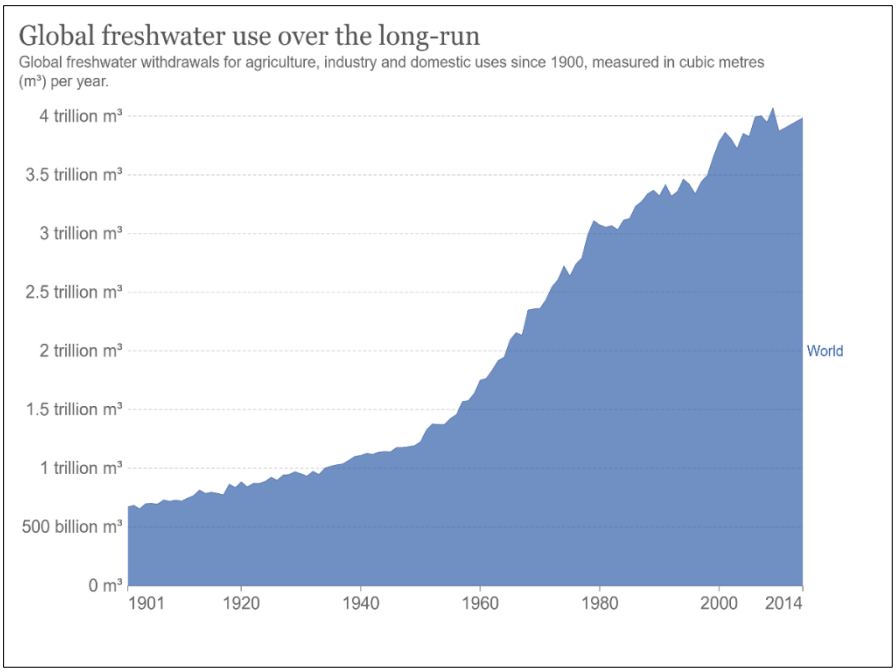


Water Quality Standards and Assessments

97.5 percent of the water that covers the earth's surface, or around 70 percent, is in the form of salty oceans. Fresh water makes up the remaining 2.5 percent, but less than 1% of it can be utilised (Figure-1.1).

In terms of population, freshwater is not distributed equally. Although Asia is home to 60% of the world's population, just 36% of the world's water resources are found there (Plan, 2005). Figure 1.2 displays the distribution of water and people in various locations. If used carefully, freshwater could sustain the entire world's population.

Figure 2: *Global Freshwater withdrawal from (1901-2014)*



Source: Global International Geosphere-Biosphere Program

Standards of Water Quality

The standards for quality of water has been provided by World Health Organization to optimize the drinking water quality for citizens. The findings are advisory, research-based, and opted after epidemiological findings of scientific research. The values of WHO are general guidelines that's why every country has demarked it according to their own social, economic and cultural pattern to meet their national priorities. Pakistan Standard Quality Control Authority (PSQCA) and the Pakistan Council of Research and Water Resources (PCRWR) have come forth with National drinking quality standards which are being used to monitor the quality of water in the area. (Rasheed H, 2021) WHO, PCRWR, PSQCA, (International Bottled water Association) IBWA, (Food and Drug Association) FDA, EPA (Environmental Protection Agency), and other countries are listed in the document for water quality monitoring criteria.

WHO Guidelines

Bacteriological Qualities

Following guidelines must be opted to check the quality of water in terms of the biological status of water (see Table 1)

Table 1: *WHO guidelines for biological standards of water*

Source/Organism	***Standard Value/Physical***
All water intended to use for drinking (Temperature tolerant type: Coliform bacteria)	Should not be found in 100ml sample of water obtained
cured water entering in distributional chain (Temperature tolerant /total coliform bacteria)	Should not be found in 100ml parts of the sample
Cured water in the distribution mechanism (temperature tolerant / total coliform bacteria TCB)	should not be found in larger samples taken in 12 months(95% of samples must not be detectable ones)

Source: Water quality monitoring based on WHO quality guidelines

Table 2: *Chemicals of Health Significance*

Cadmium	*0.003*	*Manganese*	0.500	*Selenium*	*0.010*
Chromium	*0.050*	*Mercury*	0.001	*Uranium*	*0.002*

Source: Water quality monitoring based on WHO quality guidelines

Table 3: *Other parameters*

Parameter	**mg/l**	***Parameter***	**mg/l**	***Parameter***	**mg/l**
Color	*15 TCU*	*1,2 dichlorobenzene*	1.00	*Hardness, pH,*	-
Taster, Odor	-	*1,4dichlorobenzene*	0.30	*Hydrogen Sulfide*	*0.05*
Turbidity	*5NTU*	*Tetracholoroethene*	0.04	*Iron*	*0.30*
Toluene	*0.70*	*Ethyl benzene*	0.30	*Sodium*	*2.00*
Xylenes	*0.50*	*Aluminum*	0.20	*Sulfate*	*250*
Styrene	*0.02*	*Chloride*	250	*TDS*	*1000*
Monochlorobenzene	***0.30***	***Copper***	**1.00**	***Zinc***	***3***

Source: water quality monitoring report WHO guidelines

Pesticides

Table 4: *Pesticides*

Parameter	**mg/l**	***Parameter***	**mg/l**	***Parameter***	**mg/l**
Pyradite	0.10	***Chlorotoluron***	0.03	*1dichloropropane*	0.04
Bentazon	**0.30**	***Styrene***	**0.02**	***Chloride***	**2.50**

Source: Water quality monitoring report WHO guidelines

Table 5: *Types of Pollutants*

Type	**Pollutant name**
Type A	Microbiological elements
Type B	Trace elements
Type C	Nitrate & Nitrite
Type D	Others

Source: WHO guidelines for water quality

Sources of Water Samples

Tap

No rusted taps should be sampled for water collection. Before taking samples for the study, the taps must be disinfected.

Tubewell Water

To get a representative groundwater sample, it is necessary to let the flow of water be continued for about 10 minutes.

Point of Use

The point of use must be monitored as closely as possible as the farther the sample reach, the higher the rate of pollutants added to the sample.

Hand Pumps/Dug Well

The purging of hand pumps must be carried out to make one stroke of the sample taken for testing. A general rule is if the depth of the hand pump is 30 feet deep urging surging will be needed.

Stream

While taking a sample from the streams, it should be noted that the bed of the stream must be avoided.

Dam, Rivers, Lakes

While collecting surface runoff, obtaining a sample that is actually representative is quite challenging. So, subsampling points should be taken from the bank to avoid river or dam debris in the water.

Hazard Risk Assessment

Water quality risk assessment is done based on the potential health impacts of the contaminants in the water as well as the socioeconomic effects of mitigating these contaminants. Based on the amount and kinds of contaminants present, various contaminants are assigned risk scores ranging from 0 to 1. Assessment of water quality also takes into account the type of sample, GPS reading, physical condition, and the sources from which the sample was taken. Based on test results, the area with moderately acceptable drinking water is given a risk assessment score of 0.

Low Risk: Only water samples with biological contamination or significant salt content are classified as Low Risk because these contaminants may be eliminated quickly and easily.

Medium Risk: Samples that contain potentially harmful pollutants including nitrate, fluoride, or arsenic, either singly or in combination, are categorised as medium risk.

High Risk: Water samples that include several chemical, biological, and trace element contaminants are thought to pose a high danger.

Table 6: *Risk assessment ranking method*

Type of contamination	Reason	Risk Numbers	Impact of risk
Dissolved Total solids (TDS), Coliform, and nitrate levels by acceptable ranges	By acceptable bounds	0	Safe by Portions
Only biological particles Coliforms	Bacterial contamination can be eliminated using a straightforward and affordable disinfection procedure.	1	Low Risk
Total dissolved solids only	Methods that are simple and inexpensive can lower salt content without posing a health risk from chemical contamination.	2	Low risk
Single chemical contamination	Ion-exchange particles are reuired	3	Medium Risk
Contamination caused by a single chemical and bacteria	risky to one's health. There is a need for dual and intensive treatment.	4	Medium Risk
Double chemical contamination	risky to one's health. It is necessary to undergo intensive chemical treatment.	5	High Risk
Microbiological contamination and various chemical contaminants	Risky for your health. It is necessary to undergo intensive chemical treatment.	6	High Risk

source: water quality status 2021 (PCRWR)

Table 7: *Risk Range chart*

S.N	Type of Risk	Score
a.	Low	1 to 2
b.	Medium	3 to 4
c.	High	4 to 6

Source: water quality status 2021 (PCRWR)

Quantification of Water status in Urban areas of Pakistan

Islamabad Capital Territory (ICT)

Water which is being supplied to Islamabad is mostly supplemented by ground water through more than 290 tube wells. There are many studies conducted by National Drinking Water quality Standards (NDWQS) and PCRWR to find the contamination assessment of ICT areas. The findings are mentioned as under:

Table 8: *Significant ICT characteristics that deviate from NDWQS quality criteria*

S. No	WQP (water quality parameter)	UNIT	% of Contamination in samples taken
1	Iron (Fe)	Mg/liter	18
2	Total Coliform bacteria	CFU/100 Mliter	24-25
3	E. coli	CFU/100 ml	13

Source: Drinking water quality status 2021 (PCRWR)

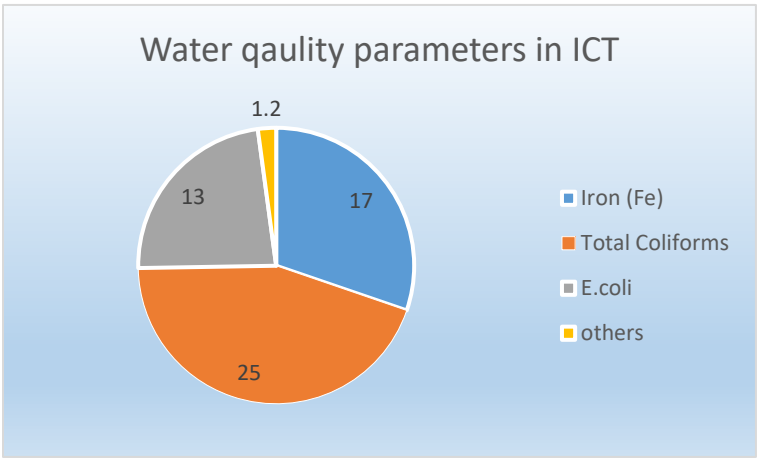


Figure 3: *showing ration in 100 ml testing samples taken in ICT*

Quantification Analysis

Biological characteristics and the presence of iron were the key causes of the study's findings that 29% of ICT's water sources were contaminated and unsafe for drinking. The Simly and Khanpur dam reservoirs are the primary sources of water. These reservoirs provide some or all of the drinking water for the region's 1.12 million residents. Coagulation, flocculation, sedimentation, chlorination, and filtration are some of the traditional ways for treating water to make it useable. The topic of a reliable supply of water in the area is raised by the level of biological components. The presence of E. coli indicated improper home sewage disposal. Time trend analysis in 2020 shows improvement by (2002-2015) from 32% to 71% due to

- Chlorination of the drinking water areas
- Disinfection steps taken a quarterly basis.

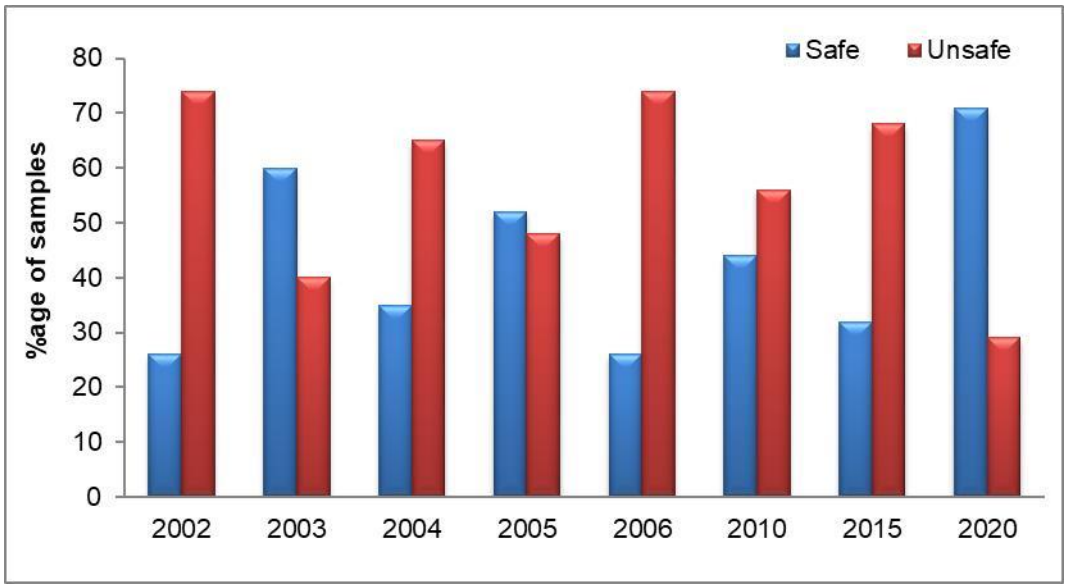


Figure 4: *ICT's annual drinking water quality status*

LAHORE

In terms of population, Lahore is the second-largest city in Pakistan. Numerous studies demonstrate that samples collected at various stations for quality investigations in urban and suburban areas contained high concentrations of arsenic, turbidity, iron, TDS, and bacteria.

Table 9: *Significant Lahore's characteristics that deviate from NDWQS quality data*

Sr. #	Water Quality Parameter	Unit	Percentage of pollution in Samples taken
1.	Arsenic (As)	µg/l	12
2.	Iron (Fe)	mg/l	17
3.	TDS	mg/l	20

Source: PCRWR: level of contamination in Lahore

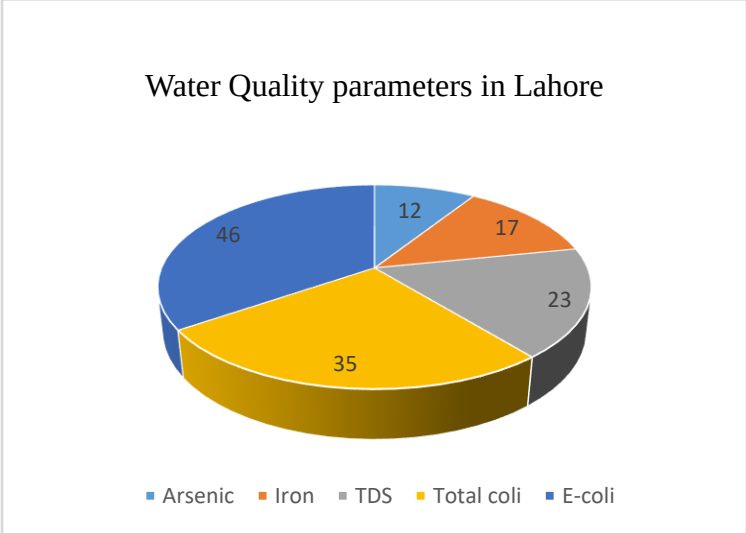


Figure 5: Demonstrates the evolution of Lahore's drinking water quality. The quality level is still rather high, but there is a minor fall in it in 2020, and the situation is essentially the same as it was in 2010.

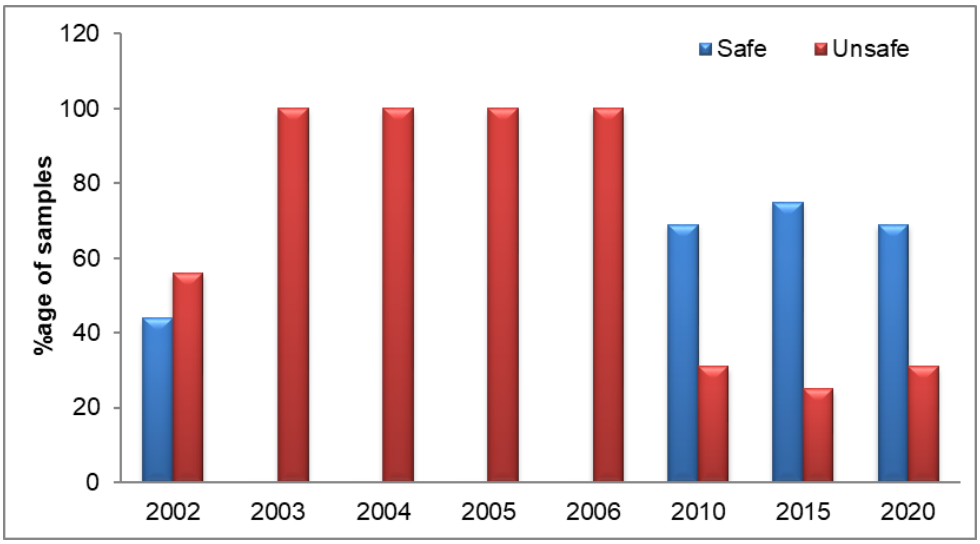


Figure 6: *yearly drinking water quality status of Lahore (PCRWR)*

FAISALABAD

The second-largest city in Punjab and third-most populous city overall in Pakistan is Faisalabad. The city is facing deteriorating quality of water with the passage of time. Hepatitus-A and gastroenteritis are common diseases in the city due to the unavailability of healthy clean water. TDS is increasing dumping waste materials from industries. various studies reveals that 46%of the water supply found polluted with Coliforms and E.coli. also excessive amount of SO4 &TDS is also present in various studies. High risk of K and Cl than permissible limits was also found.

Table 10: *Significant Faisalabad Characteristics that deviate from NDWQS Quality data*

Sr. #	Water Quality Parameter	%age of Contaminated Samples
1	Chloride	23
2	Flouride (F)	8
3	Hardness	12
4	Iron	21
5	Nitrate	16
6	TDS	24
7	Total Coliform	15
8	E-coli	15

Source: *PCRWR Level of water contamination in Faisalabad*

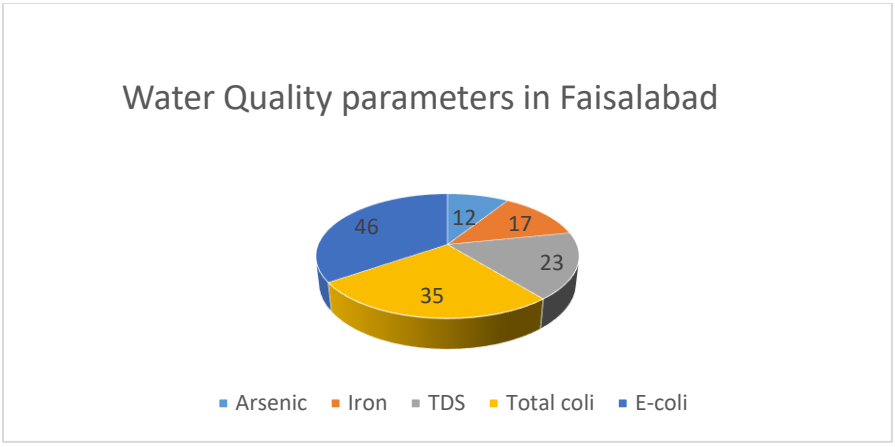


Figure 7: *Water Quality Parameters in Faisalabad*

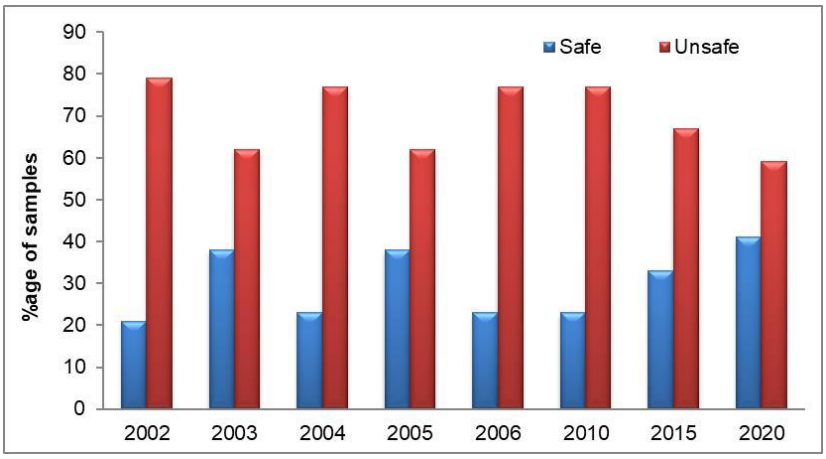


Figure 8: *Yearly drinking water quality status of Faisalabad (PCRWR)*

KARACHI

Karachi with 60% industries of the country is the largest city of Pakistan which is dependent on surface water and ground water. Many studies shows that about 93% of the water is titled as unsafe to drink. Groundwater has NACL and sodium bicarbonate (NaHCO3) which indicates the presence of seawater belonging to Sodium Chloride and permanent water hardness.

Table 11: *Significant Karachi Characteristics that deviate from NDWQS Quality data*

Sr. #	Water Quality Parameter	Unit	%age of Contaminated Samples
1	Chloride (Cl)	mg/l	11
2	Flouride (F)	mg/l	7
3	Hardness	mg/l	4
4	Turbidity	NTU	4
5	TDS	mg/l	11
6	Total Coliforms	MPN/100 ml	93
7	E-coli	MPN/100 ml	36

According to recent assessments, the situation in Karachi has gotten worse and shows little sign of change. The damaged water supply pipelines and sewage lines frequently run parallel to one another, exposing them to a higher risk of contamination that is responsible for a number of gastrointestinal disorders.

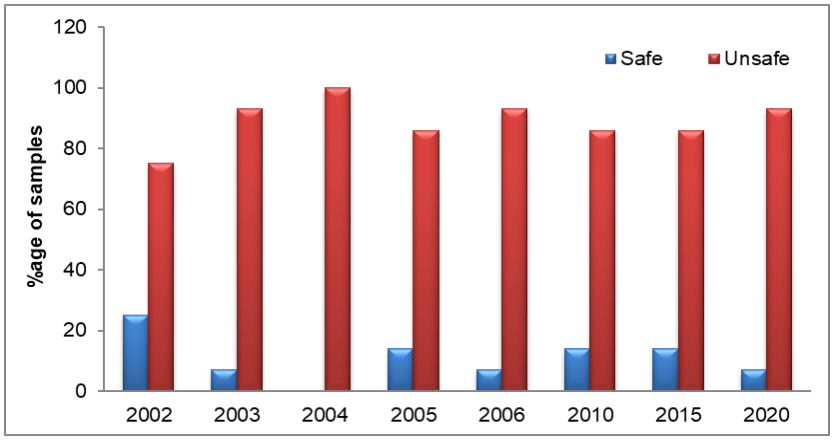


Figure 9: *Yearly drinking water quality status of Karachi*

Effects of contaminated water on Human Health

Surface Water Contaminations

As a result of insufficient treatment, monitoring, and sanitation systems, the quality of drinking water decreases. Hazardous substances and microorganisms present in drinking water have a harmful impact on human health. There have been numerous cases of waterborne illnesses. in rural cases of waterborne illnesses in Pakistan's cities, Typhoid, cholera, hepatitis, and dysentery are often reported diseases. The hazard caused by many circumstances can be estimated, although it is quite difficult to do so. Clinics and hospitals dealing with ailments caused by poor water quality, inadequate healthcare record-keeping, and underreporting of illnesses are a few examples. Numerous research have shown that poor drinking water quality has negative effects on people's health. For instance, it was shown that infants who were bottle-fed had nitrate (NO3) concentrations that were higher than allowed, resulting in blue baby syndrome. (F. X. R. Van Leeuwen, 2009). The usual daily potassium (K) intake of adults via water was determined to be less than 0.1 percent. A certain amount of K, like other elements, is required for the body to function effectively. A spike in blood K levels may result in cysts, poor renal function, a quick heartbeat, and inappropriate protein metabolism, whereas a decrease may result in hypertension, kidney issues, heart problems, muscular weakness, bladder weakness, and asthma.. (F. X. R. Van Leeuwen, 2009). Sodium (Na) enters the water mostly through mineral deposition. An increase in the body's Na level may induce kidney troubles, nausea, headaches, hypertension, and stomach problems while a reduction may cause fatigue, mental apathy, sorrow, and low blood pressure. (Garn, 2016)· The lack of basic cations like calcium and magnesium has been linked to cardiovascular disease (G Robert, 2003)· The essential Iron is a critical component of myoglobin, haemoglobin, and many other enzymes (Fe). More Fe in the body might potentially be harmful to one's health. Issues such as cardiovascular system degradation, central troubles with the neurological system, the liver, the kidneys, and diarrhoea (C.-Y. Yang, 2006)

Contaminations of Subsurface Water

A qualitative investigation of drinking water resources revealed that the physical characteristics of three sampling locations, including bore wells, dug wells, and hand Pumps were not installed in accordance with PEPA's and WHO recommendations (Goldhaber, 2003). However, samples taken from a tube well shown in accordance with the recommendations made by PEPA and WHO · There was turbidity in the samples that were taken. Tube well as opposed to hand pumps, bore wells, and excavated wells samples of water were discovered to be turbidity-free. E.C. and was exceeded by the TS, TDS, and TSS contents (Podewils LJ, 2007). The disease, which would otherwise be preventable, is largely brought on by unsafe drinking water, especially in young children in underdeveloped nations. Each year, 2.5 million people die from the endemic diarrheal disease that is brought on by pathogens found in drinking water, including several viral, bacterial, and protozoan agents (Daud MK, 2017)· Major health issues mentioned by respondents were gastroenteritis (40–50%), diarrhoea (47–59%), dysentery (28–35%), hepatitis A (32–38%), hepatitis B (16–19%), and hepatitis C (6-7%) (Ali SA, 2009)· Waterborne illnesses such diarrhoea, vomiting, gastroenteritis, dysentery, and renal issues are brought on by contaminated drinking water in southern Sind. (Daud MK, Drinking Water Quality Status and Contamination in Pakistan., 2017)

Diseases by Subsurface and Surface Water Contamination: A Global Perspective

The contamination of ambient water bodies with water-borne pathogens, as well as the diseases they induce, is a major global water quality issue. Water-borne illnesses (such as diarrhoea and gastrointestinal disorders) caused by various bacteria, viruses, and protozoa leading to several outbreaks.United Nations Children's Fund estimates (UNICEF) polluted water causes the deaths of 4,000 children per day.(WHO,2014), Typhoid, cholera, hepatitis, and dysentery are frequently reported diseases. The hazard caused by other factors can be estimated, although it is quite difficult to do so. Clinics and hospitals dealing with ailments resulting from poor water quality, inadequate healthcare record-keeping, and underreporting of illnesses are a few examples. Numerous research have shown that poor drinking water quality has negative effects on people's health. For instance, it was shown that infants who were bottle-fed had nitrate

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National Security Management

Sources protection from contamination, modernized advancement and correct maintenance of drinking water distribution lines, and monitoring and public awareness should all be included in management strategies.

- Legislative control
- Governance
- Proper maintenance of distribution of water
- Industrial Treatment plants
- Public Awareness programs

Conclusion

The water quality conditions continue to be unsatisfactory in both metropolitan cities and or a countryside population. Most areas in Pakistan face even worse conditions the worse condition. The current study demonstrates that as a result of insufficient treatment, monitoring, and sanitation systems, the quality of drinking water decreases. Hazardous substances and microorganisms present in drinking water have a harmful impact on human health. There have been numerous cases of waterborne illnesses. In rural cases of waterborne illnesses in cities of Pakistan, dysentery, cholera, typhoid, and hepatitis are routinely reported. However, it is extremely challenging to accurately estimate the hazard brought on by various factors. Waterborne diseases are also spread by the sources of water carried by taps, wells, and tube wells. A significant global problem with water quality is the contamination of ambient water bodies by water-borne microorganisms and the diseases they cause. Numerous outbreaks have been brought on by water-borne illnesses (including diarrhoea and gastrointestinal problems) brought on by different bacteria, viruses, and protozoa. 4,000 children die per day as a result of dirty water, according to estimates from the United Nations Children's Fund (UNICEF) (WHO, 2014). The diseases typhoid, cholera, hepatitis, and dysentery are frequently recorded. Although it is fairly challenging to do so, it is possible to assess the risk brought on by numerous conditions. Examples include clinics and hospitals that treat illnesses brought on by poor water quality, poor healthcare record-keeping, and underreporting of illnesses. Even running water is contaminated by various faecal pollutants on the way. Strict legislation is needed in this regard that water-providing authorities should check not only the adequate provision of clean water but safe drinking water quality must be maintained by the authorities. As lesser quality standards give rise to diseases in the area that contribute to a relatively high mortality rate. Distribution of water must be carried through safe sources where all quality standards have been implemented and functional.

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Conflict of Interest

Authors have no conflict of interest.

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